STUDENT EXPERIENCE AND SENSE OF PLACE ON GEOSCIENCE FIELD TRIPS

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

THE COLLEGE OF SCIENCE

(Geological Sciences)

THE UNIVERSITY OF CANTERBURY

Christchurch, New Zealand

October 2017

ABSTRACT

Field education is a vital component of undergraduate degree programmes in geoscience, but many aspects of this experience are not well understood. The experience of the individual student during a field trip is strongly influenced by affective factors (emotion, motivation, and connection to Earth). How these factors interact in the context of different field trips is poorly understood. This thesis aimed to address how students connect to the locations of their field trips, by investigating their sense of place in a variety of teaching and learning environments. Mixed-methods approaches were used to compare different styles of field education in three studies: (1) field pedagogy/structure, (2) instructor and weather, and (3) student nationality/programme.

Study 1 findings show that on average, students significantly increased in their attachment to the situated field area and had no change in their attachment to the roadside field area. The situated field trip utilised more student-centred pedagogy and student perceptions of learning were closely aligned with instructor intentions. The roadside field trip was less student-centred, did not involve a regional-scale assessment, and students felt spatially disoriented in the field area. Student perceptions were not as closely aligned with instructor intentions on the roadside field trip. Additionally, the situated assessment allowed instructors to model landscape appreciation, whereas the discrete roadside assessments were less supportive of regional geological connections.

Findings from study 2 show that on average, students on all field trip streams had significant increases in their place attachment. There were no significant differences in attachment between streams, despite variations in instructor pedagogy. Instructors had consistent learning outcomes and valued the field area for its educational opportunities, both of which were clear to students. Inclement weather had no significant impacts on students' sense of place or field experience. The field trip assessment was connected to the landscape and had in-built flexibility for the influence of external factors. Instructors also adjusted student autonomy in response to varied weather conditions.

Study 3 findings indicate that on average, study abroad students were significantly more intrinsically motivated, placed significantly more task value on the field trip, and had significantly lower test anxiety. Study abroad and local students had no significant differences in their control of learning

beliefs and self-efficacy for learning and performance. On average, study abroad students were more pro-environmental (though not statistically significant), and had significantly higher place attachment and place meanings towards the field area.

Based on these studies, a new conceptual model for field trips was developed, highlighting the interrelationships between: (a) the individual student, (b) their peer group, (c) their instructor(s), (d) the landscape (field area), and (e) the field trip assessment. This model may be used when designing or modifying field pedagogies by adjusting these interrelationships. Specific recommendations are made for each of the contrasting field educational cases:

(1) Situated field trip curricula should maintain aspects of autonomy and assessment integrated with the field area. Roadside field curricula would benefit from ensuring that students are encouraged to discover regional connections for themselves, and we recommend that this is supported through the assessment structure.

(2) To support resilience of field trips to differing instructors and weather, it is important that instructors value field education, have similar intended learning objectives that are clear to students, appreciate the field area for its educational features, and exercise flexibility in the assessment structure.

(3) Student outcomes on study abroad field trips may be enhanced by more applied, environmentally-focused, or place-based curricula. Curricula should be adapted with a specific audience in mind, rather than applying local field trips without consideration.

The thesis highlights ways in which student connections with field places may be strengthened to better address learning outcomes and develop more environmentally and socially conscious graduates.

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CO-AUTHORSHIP STATEMENT

The body of this thesis contains three manuscripts that will be submitted or are already in review for publication.

Chapter 2 is in review with *Geosphere*. The authorship is as follows: myself, Dr. Ben M. Kennedy, Dr. Erik Brogt, Dr. Samuel J. Hampton, and Dr. Lyndon Fraser. I completed the data collection and analysis, and drafted the manuscript. Dr. Kennedy helped develop a conceptual model for the manuscript. Dr. Brogt helped with its structure. Dr. Hampton helped draft the figures. Dr. Fraser helped with methods of qualitative analysis. All co-authors assisted in editing the manuscript.

Chapter 3 will be submitted to the *Journal of Geography in Higher Education.* The authorship is as follows: myself, Dr. Samuel J. Hampton, Dr. Erik Brogt, Dr. Ben M. Kennedy, Dr. Lyndon Fraser, and Angus Knox. I completed the data collection and analysis, and drafted the manuscript. Dr. Hampton helped maintain connectivity to the teaching and learning environment, and helped refine the figures. Dr. Brogt helped constrain the qualitative analysis and situate the findings in educational theory. Dr. Kennedy helped develop a conceptual model and maintained practicality in the recommendations. Dr. Fraser helped refine the reporting of the research setting. Angus Knox helped with some of the data collection and contributed to early discussions of observations in the teaching and learning environment. All co-authors assisted in editing the manuscript.

Chapter 4 has been submitted to *Frontiers: The Interdisciplinary Journal of Study Abroad.* The authorship is as follows: myself, Dr. Erik Brogt, Dr. Ben M. Kennedy, Dr. Samuel J. Hampton, and Dr. Lyndon Fraser. I completed the data collection and analysis, and drafted the manuscript. Dr. Brogt helped refine the recommendations and improve their usefulness to practitioners. Dr. Kennedy helped with the integration of data sets and recommendations. Dr. Hampton helped understand the study populations. Dr. Fraser helped with the integration of qualitative data. All co-authors assisted in editing the manuscript.

ACKNOWLEDGEMENTS

This research was funded by a University of Canterbury Doctoral Scholarship. Conference attendance was supported by Mason Trust Awards (2014 and 2016), Geoscience Society of New Zealand Student Travel Grants (2014-16), and a Geoscience Education Division of the Geological Society of America Student Travel Grant (2014). Frontiers Abroad and the Department of Geological Sciences were in full support of having the research conducted on their field trips, and generously provided accommodation and catering. The University of Canterbury owns and maintains field stations at Cass and Westport, and Bo and Georgie McRae of Glens of Tekoa Station allow access to their land each year. Tom Johns from Environment Canterbury provided weather data presented in Chapter 3.

I have been extremely fortunate to have an incredible team of supervisors who have helped me grow as a researcher, an educator, and a person. Ben Kennedy and Erik Brogt have been my biggest champions ever since I was their research assistant in 2011-2012. I will be forever grateful for the opportunities that they have provided me, the patience they have shown in many a challenging time, and the lessons that I will take forward in my career. Sam Hampton has been a jack of all trades, effortlessly integrating findings with practitioner knowledge. He has been a crucial personal support throughout my PhD, reminding me that there is always value in stepping back to make an assessment. Lyndon Fraser has provided invaluable perspective from outside geoscience and science education that has undoubtedly made this work more rigorous, yet still accessible.

This work has been shaped by countless conversations with colleagues at uni, in the field, over Skype, or at the pub. Louise Vick, Rebecca Jolley, Alex Wilke, Jason Hursthouse, and Bec Fitzgerald provided sanity checks of a chapter each at short notice, which was much appreciated. Jackie Dohaney and Paul Ashwell, I am grateful for so many critical discussions over craft beer – even if they usually devolved into intense rants! I'd like to thank David Bell, Josh Borella, Max Borella, Jonathan Davidson, Brendan Duffy, Darren Gravley, Travis Horton, Kate Pedley, Jarg Pettinga, Tom Wilson, and Val Zimmer for always challenging me to push harder and inspiring me with their dedication to teaching and learning. Lindsey Conner, Chris North, Billy O'Steen, Valerie Sotardi, and David Winter all provided useful points of contact for discussion from the College of Education.

Chris Atchison, Anthony Feig, Steve Semken, and Alison Stokes – you all inspire me immensely and have made me feel so welcome in the geoscience education community. I owe all of my interest in and early experiences with discipline-based educational research to the Science Education Initiative at the University of British Columbia. Josh Caulkins, Brett Gilley, Sara Harris, Francis Jones, and Erin Lane – thank you for nurturing me and setting me on the path to be the confident and capable researcher I am today.

Like any science, educational research benefits from having a second eye on things. Field assistants Angus Knox (Glens of Tekoa) and Landis Powell (Cass) were a great help in collecting observations, discussing ideas, and just generally providing good company and banter in the field.

From the early days of W3C, all the postgraduates in the Department of Geological Sciences (and alumni) have been absolute superstars, encouraging and supporting me in all aspects of my life. There are too many to name, but I'm still going to give it a try. Weasel, Sozzle, Jo, Sceb, Red Elephant, Moz, Rainbow Pony, Tutbunny, Flo, Smaug, Christoofar, Jake, Bubba, Shamu, Slaw, Kay, Ham Ham, Rodent, Frizzle, K Diggity, Joshyte, Saus, Jorge, Ali, Dan, Hammer, Liz, Lorelei, Donna, J-Balls, Pashwell, and Fraser. Special mention to Tommo/PT, who has been my officemate through three different offices in two different buildings. It has been so important to have someone nearby who is at a similar stage in their PhD as me. I can't thank you enough for all of the chats, hugs, high fives, and LoBro's over the last three and a half years. The LPM's have seriously been off the chart!

Over the past couple of years, I have had an epic crew of people by my side at countless gigs, always keen to cut some serious shapes. Music has no doubt been key in getting me through my PhD and having excellent company on the d floor has made these momentz even more magical. Wilkatron, K-Mac, Waddo, Big Meech, Mus, Le Hoe, Joney, Blaker, Ellie, Morgz, Smate, and Sophie – turn up "Redbone" and revive yourselves once more!

UC Hockey and the Aztecs been a great source of stress relief and physical activity over the last three years, and this has particularly helpful over the last few months while I've been finishing up. I'd especially like to thank the core group that has put up with me the entire time – Greer, Trotty, Jenny, and Box. You're all absolutely lovely ladies who give more than your fair share of encouragement and great chat on and off the pitch!

Beginning with my first time living in New Zealand, I've had the pleasure of flatting with many phenomenal characters. My Peer Street family (Simon, Sammy, Jimmy, James, Brierly, and Tom R) welcomed me to the country and made sure that Christchurch had a piece of my heart from the get go. The Pikachu Girls (Louise and Emma) made me feel like I had never left NZ. The Gobham flatties (Ollie, Tom G, and Jodie) somehow managed to mix class with silliness in a way that was absolutely effortless. The Cooligan Hooligans (Tom G, Mary, Nick, Andy, Jase, Tom J, Rory, Czaap, Eva, Nathaly, David, Stan, and Etch) showed me what it was like to make full use of a six-bedroom (+ wardrobe) flat, including a deliciously warm spa. Finally, the specimens at the Huntingdon Country Club (Becs, Wilke, Jase, Tom J, and honorary flatmate Angus) married the vibe of Colligan with the rich air of Avonhead. Perhaps most importantly, the Country Club has tolerated me during the last six months of my thesis, which I'm sure was no easy feat!

Amey, Dean, Scott, and Rebecca – you have always been incredibly supportive of my decision to live almost as far as I possibly can from Canada. I love you so much. Your little chats, words of encouragement, care packages, and cards have meant the absolute world to me. I look forward to every year when I get to come back for a visit, and being far away for most of the year makes that time so much sweeter! Although it has not always been easy being at a distance, I have always felt the support of my extended family in Vernon, Lethbridge, Calgary, and Burlington. My chosen/Vancouver family has never wavered in their encouragement either. Lau, Kate, Steph H, Steph S, and Halley – you are some of the most confident and badass women I have had the pleasure of knowing, and you all constantly inspire me in so many ways.

Finally, educational research would not be possible without student and instructor participants. I would like to extend my warmest appreciation to those that contributed their time and opinions to this research, all in the name of improving future science education.

DEDICATION

This thesis is dedicated to my Aunt, Tannis Scheuerman (Jolley), an amazingly warm, loving, and inspirational person. If you could see this, I know you would be proud. Thank you for always being supportive of my endeavours and for bringing positivity and laughter to every room you entered.

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

'Fieldwork', in the physical sciences, is typically used to describe time spent collecting data, researching and/or learning outside, often for an extended period (i.e., greater than a weekend; e.g., Gold et al., 1991; Manning et al., 1998). Learning in the field is valued in geology (e.g., Kastens et al., 2009; Whitmeyer et al., 2009; Petcovic et al., 2014) and is utilised in other disciplines such as geography (e.g., Kent et al., 1997; Nairn et al., 2000; Fuller et al., 2006), biology (e.g., Smith, 2004; Anderson et al., 2009), archaeology (e.g., Colley, 2003; Colley, 2004) and in-service teacher training (e.g., Crawford, 2007; Wee et al., 2007; Luera and Murray, 2016). Regardless of the disciplinary content, education in the outdoors is widely appreciated for providing immersive learning experiences involving people and natural resources that complement the classroom (e.g., Priest, 1986; Rickinson et al., 2004).

Although highly valued, there is still a lot to uncover about the field educational experiences in geoscience (e.g., Gold et al., 1991; Whitmeyer et al., 2009; Petcovic et al., 2014). Geoscience education researchers have highlighted the need for more study in the affective domain – emotions, attitudes, and values (e.g., Feig, 2010; McConnell and van der Hoeven Kraft, 2011; van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013). Attention to the affective domain connects geoscience content with motivation for learning and the adoption of effective learning behaviours (McConnell and van der Hoeven Kraft, 2011). Not only does this have the potential to improve individual student outcomes, it also has wider implications for recruitment and retention of majors, including underrepresented groups (LaDue and Pacheco, 2013). Field trips are commonly reported by geoscientists as experiences that attracted them to or retained them in the discipline (Levine et al., 2007; Houlton, 2010; LaDue and Pacheco, 2013). In their study on perceptions of the value of field education, Petcovic et al. (2014) found many learners, instructors, and industry professionals considered field experiences "inspiring, motivating, exciting, or engaging" (p.6). Yet, Feig (2010) noted the lack of research on what he terms the "essence" (p.213) of student field experiences. He draws attention to the importance of understanding "how students construct reality" both as individuals and within the class group (Feig, 2010, p. 214).

This thesis seeks to address some of these lesser studied areas of geoscience education, by uncovering specific aspects of lived experiences in the field. The primary focus is how undergraduates relate to their field locations through connections with Earth, using the concept of sense of place. This is investigated by contrasting several field trip variables: (1) field pedagogy/structure (Chapter 2), (2) instructor (Chapter 3), (3) weather (Chapter 3), and (4) student nationality/programme (Chapter 4). Chapter-specific research questions and a more detailed overview are presented at the end of this Chapter (Table 1.1). Three broad research aims are addressed:

(1) **To uncover the nature of the development of sense of place in undergraduate geoscience students in the field (Chapters 2 and 3)**

(2) **To illustrate how the development of sense of place is impacted by differences in field trips or students (Chapters 2, 3 and 4)**

(3) **To understand how sense of place relates to motivation and environmental attitudes (Chapter 4)**

Though research was conducted on geology field trips during the 2015 academic year, it is expected that findings will be relevant to other disciplines with field educational components, as well as the broader fields of outdoor and environmental education. The wider implications of these findings are discussed in Chapter 5. An improved understanding of the affective experiences of students in the field will aid in providing higher quality, responsive field education and in turn, produce more competent and connected geoscientists. Moreover, it helps to provide tangible evidence for the continued importance of field education in the learning pathways of geoscientists.

The following literature review (this chapter) synthesises relevant knowledge from many fields, including: geoscience education, outdoor education, environmental education, human geography, environmental psychology, educational psychology, and anthropology. It compiles and connects this knowledge in the context of the thesis aims and builds towards chapter-specific research questions. The literature review begins with locating the research and researcher, including theoretical frameworks, approaches to methods, and positionality. Prior research in geoscience field education is detailed, including benefits, challenges, approaches, and thinking in the field. A broad review of research on human-environment interactions is discussed, and each aspect is related back to geoscience. Finally, chapter-specific research questions are presented, along with an overview of the thesis structure.

1.1 – Locating the Research(er)

Research questions involving the lived experiences of participants require some aspect of qualitative study, due to their rich, difficult to quantify nature. In qualitative studies, the researcher is an active participant and thus, it is important to define how the researcher (and the research) sits within the study environment and the study itself (Feig, 2011). This helps the reader understand why and how the study was conducted, and contributes to establishing trustworthiness in the study (e.g., Krefting, 1991; Creswell and Miller, 2000; Shenton, 2004). More specific discussions of trustworthiness as they pertain to each component of the thesis are contained within Chapters 2, 3, and 4. The next section serves to provide a theoretical context for the research, thereby guiding lines of inquiry and selection of methods.

1.1.1 – Theoretical Frameworks

1.1.1.1 – Educational frameworks: motivation

In studying the affective domain, this research leans most heavily on motivational theory (e.g., Bandura, 1977; Dweck, 1986) and more specifically, self-determination theory (e.g., Deci and Ryan, 1985; Deci et al., 1991; Ryan and Deci., 2000; Eccles and Wigfield, 2002). Self-determination theory uses a continuum to explain how people behave in response to varied perceptions of choice and control (Deci and Ryan, 1985). “Autonomy orientation” (p.111) is the most self-determined causality, where people draw on their interests and choice to influence behaviour. “Control orientation” (p.111) is less self-determined than autonomy orientation, and defines behaviours that tend to be dictated by extrinsic factors that exert pressure on the individual. “Impersonal orientation” (p.111), the least self-determined behavioural orientation, describes behaviours that are seemingly out of the individual’s control. In this case, the individual may feel incompetent or unable to master a task (Deci and Ryan, 1985).

Deci et al. (1991) applied self-determination theory to education and suggested that there are three human needs essential to generating motivation and improving performance: (1) competence, (2) relatedness, and (3) autonomy. Social contexts are crucial enablers for these needs (Deci et al., 1991), and fulfilment of these helps to promote intrinsic motivation, or motivation driven from within the person (Ryan and Deci, 2000). Eccles and Wigfield (2002) summarised three drivers for intrinsic motivation: "preference for hard or challenging tasks", "learning that is driven by curiosity or interest" and "striving for competence and mastery" (p.114). Intrinsic motivation is desired in students, as those that are intrinsically motivated have been shown to have greater conceptual understanding (e.g., Benware and Deci, 1984; Grolnick and Ryan, 1987) and more positive emotions about and enjoyment of learning (Vallerand et al., 1989).

1.1.1.2 – Educational frameworks: pedagogy

In some ways, students in the field have more attention from their instructors than they do in the classroom. In the field, student and instructors tend to have one-on-one interactions that directly address outcomes during the teaching and learning process. Distractions from other coursework and social engagements are minimised, and instructors and students both put dedicated energy into the same task. However, on traditional mapping-based field trips, students spend more time without their instructors than they do with them. They need to make independent decisions, such as where to go and how to manage their time (e.g., Mogk and Goodwin, 2012; Baker and Petcovic, 2016). Students also need to make decisions about their own learning, such as what information they need to prove/disprove multiple working hypotheses (e.g., Riggs et al., 2009). These examples show how the field learning environment fosters self-determination by supporting student autonomy (Deci et al., 1991). Autonomous/student-centred learning incorporates student choice and active learning, and relies upon mutual respect and interdependence between student and instructor (O'Neill and McMahon, 2005). Students are given the primary power to make decisions about their learning (O'Neill and McMahon, 2005).

Previous work has found that when students perceive more autonomy support from their instructors, they have significant increases in their own perceived competence and interest (Black and Deci, 2000). Coincidentally, they also have decreases in their anxiety (Black and Deci, 2000). Furthermore, these students also perform better in the course (Black and Deci, 2000). Students who perceive more support for autonomy from their instructors tend to adopt deeper approaches to learning, but this may be tempered if they are unsatisfied with contextual factors such as workload, clarity of goals, or career relevance (Baeten et al., 2010). Adopting a transactional view of student-centred learning may help to better manage these factors. In this approach to student-centred learning, students and instructors assume joint responsibility for student outcomes (Elen et al., 2007). Instructors monitor the learning process, but differentially take a leading role as students actively construct and regulate their own learning (Elen et al., 2007).

In self-determination theory, the importance of social context in fulfilling needs for intrinsic motivation is highlighted (Deci et al., 1991). There is rich potential to develop and strengthen intrinsic motivation through social factors in the field, as they are an integral part of the teaching and learning environment (e.g., Gold et al., 1991; Boyle et al., 2007; Stokes and Boyle, 2009; Petcovic et al., 2014). Streule and Craig (2016) comprehensively applied Wenger's (1998) social theory of learning to field education. Field learning is practical, discussion-rich, and develops student identities (as geoscientists) – all key components of social learning (Streule and Craig, 2016). Field trips require and strengthen communication and teamwork skills, necessary in a subject as interdisciplinary as geoscience (Streule and Craig, 2016). This combination of identity and interaction leads to a community of practice – one in which participation is necessary to achieve experiential learning (Streule and Craig, 2016).

1.1.1.3 – Methodological frameworks

The qualitative methods used in this research are informed by two naturalistic theoretical frameworks: phenomenology and ethnography. Phenomenology is the descriptive study of how people understand a lived experience or phenomenon (Starks and Trinidad, 2007). Participants reflect on their experience, as a primary interpretation (Bevan, 2014), and the researcher makes secondary interpretations during the analysis process. Ethnography observes how people behave in certain settings, through extended contact between the researcher and sample group (Hammersley, 2006). The group dynamics, or social community, are integral to ethnographic studies (Wilson, 1977). Phenomenology allows us to understand the internal framework within which people perceive their experience and ethnography documents the external expression of this experience. Together, the two comprise the methodology of phenomenography, to observe and document personal accounts, perceptions, and actions as components of a shared experience in the world (e.g., Trigwell et al., 1994; Trigwell and Prosser, 1997; Feig, 2010). Phenomenography fits well with studies of field education because the field involves complex experiences of individual students as they exist within a class group in the field environment (the nature of this complexity is discussed in detail in section 1.2). This thesis integrates personal perceptions and reflections (questionnaires, interviews) with contexts and behaviours occurring in the group environment (observations).

1.1.2 – Approach to Methods

In documenting student field experiences, and particularly in doing so with a phenomenographic approach, qualitative methods are essential (e.g., Cohen et al., 2007; Feig, 2010; Feig, 2011). Details about subjects' perceptions and lived realities are necessarily rich and unique (e.g., Feig, 2010; Feig, 2011; Williams and Semken, 2011). Qualitative analysis allows room for multiple experiences and interpretations, avoiding objectivity (Feig, 2011). However, qualitative data require more effort in both the data generation and analysis process.

This work utilised qualitative methods of observation and semi-structured interviewing, common to phenomenologic and ethnographic analyses (e.g., Wilson, 1977; Cohen et al., 2007; Bevan, 2014). Observations, in the form of field notes, provided an understanding of the educational context of the field trips studied and descriptions of student and instructor behaviours occurring in the field (Feig, 2011). Interviews allowed for more detailed documentation of individual perceptions and experiences related to a phenomenon, i.e., the field trip (Bevan, 2014). Interviews also have the benefit of being able to clarify or further probe the interviewees' answers, until the interviewer is satisfied that they understand the experience or perceptions described (Cohen et al., 2007). In contrast, prewritten questionnaire options do not characterise why participants answered the way that they did (Feig, 2011).

Although prewritten options do not characterise the reasons behind participant answers, quantitative data provide larger sample sizes that are easily accessible to the researcher, and the data return increases considerably with marginal increases in effort (Cohen et al., 2007). As conducting and analysing interviews from every single student on each field trip is not only inefficient but outside of the scope of a doctoral thesis, quantitative methods of pre-post field trip questionnaires were used to help contextualise and triangulate qualitative findings (e.g., Greene et al., 1989; Bryman, 2006). Together, quantitative and qualitative data provide a robust and complementary combination of research methods. Chapters 2 and 3 draw from mixed-methods designs, incorporating both quantitative and qualitative data. Chapter 4 is almost entirely quantitative, but incorporates qualitative elements to provide individual perspectives behind the quantitative data.

1.1.3 – Positionality Statement

Researcher reflexivity, or self-disclosure of personal beliefs and values, helps to establish trustworthiness in qualitative research (Creswell and Miller, 2000). In the case of this thesis, the researcher acts as a "researcher-observer" (Feig, 2011, p. 6). The researcher was not a participant in the field trips, but she was present on all of them, recording thick descriptive observations (Geertz, 1973). These observations were active – students and instructors were occasionally engaged in conversations to elicit thought processes and field approaches (Feig, 2011). Additionally, some students and instructors later participated in semi-structured interviews (Cohen et al., 2007).

At the beginning of each trip, the role of the researcher was detailed. Students were made aware that though the researcher was a postgraduate student, they were not present as a demonstrator/tutor and therefore could not answer questions regarding the content of the course. It was important to make this clear to minimise power imbalances between the students and researcher. If students perceived the researcher as having some bearing on their performance on the field trip, they might feel coerced to participate or position themselves in a way to provide socially desirable, instead of honest, responses (e.g., Ritchie and Rigano, 2001).

In reality, these divisions between students as participants and researcher as detached observer were not always easy to uphold. The existence of a researcher on the field trip would have shaped how students behaved and responded, no matter how much we tried to control for this. Students may have tempered their comments and actions in the presence of a person with more senior stature, or they may have been more inclined to reflect upon the educational aspects of the field trip than they normally would. Lecturers may have adjusted their teaching to include more place-based aspects. There is no way to truly be invisible as a researcher without the use of deception, which is not justifiable in a study of this nature.

Students, particularly those that had been taught by the researcher in a previous capacity, were tempted to ask the researcher questions about the field trip content. Likewise, it was challenging for the researcher to avoid assisting the students, particularly where it was unclear when they might next encounter a lecturer or demonstrator. Feig (2010) describes separating his identity as a teacher from what he observed in the field as "impossible" (p. 216). Ultimately, the cases where students already knew the researcher (because they had been tutored by her in laboratories or field trips unrelated to this thesis) were viewed as more of a help than a hindrance, as they built rapport before the studies began.

The following two paragraphs are a reflection on my own personal beliefs and experiences. I completed degrees in Geological Sciences (B.Sc. Hons.) and Geoarchaeology (M.Sc.), both of which had significant field components, before conducting this study. I enjoyed these field experiences immensely, though at times they were physically and mentally demanding. I have long enjoyed tramping/hiking, and the lure of being able to conduct scientific research in the outdoors was an important contributor to my interest in geoscience. I believe that the field is an essential component to learning geoscience, but I am interested in understanding how these environments may be improved or replicated for those to whom the field is partially or completely inaccessible for a variety of reasons. I personally have experienced sexism on field trips at the hands of peers and instructors, and I am aware of many others who have experienced discrimination because of their gender in both field learning and career settings. I cannot personally understand the exclusionary nature of the field environment for people of colour, persons with disabilities, and people from lower socio-economic backgrounds, but I do believe that inequities exist and this list is by no means exhaustive.

As an expatriate from Canada, I can relate to the study abroad students in this study that are experiencing life in New Zealand for the first time. I do not have the childhood familiarity with New Zealand landscapes that local students do. I have developed my own familiarity with the landscape by travelling extensively and spending time in the outdoors. I have formed strong attachments with New Zealand, and with many of the landscapes on the South Island. I have also had repeated visits to specific field trip locations for both research and teaching purposes, and have built strong relationships with them myself.

1.2 – Teaching and Learning Geoscience in the Field

This section details a selection of literature relating to geoscience field education. We include work from geology and geography under the broad term 'geoscience'. The first sub-section (Section 1.2.1) concerns the benefits of field education to learners. The recommendations made later in this thesis (Chapter 5) serve to leverage what is already an important part of undergraduate geoscience programmes and enhance these benefits. This discussion of the benefits of field education is complemented by a discussion on the challenges of implementing successful field-based curricula (Section 1.2.2). Recommendations provided in this thesis (Chapter 5) show how we can address some of these challenges to improve outcomes for varied learners and replicate field experiences in non-traditional teaching and learning environments. Next, the various styles or pedagogical approaches to field educational curricula are described (Section 1.2.3), including unexpected aspects of the field environment. Finally, research on student thinking in the field, including cognitive and affective processes, is summarised (Section 1.2.4).

1.2.1 – Benefits of Field Education

The building of geoscientific knowledge begins with observations of the Earth (e.g., Ernst, 2006; Kastens et al., 2009; Mogk and Goodwin, 2012). Though fieldwork is not unique to geoscience, the process of geologic/bedrock mapping is (e.g., Ernst, 2006; Petcovic et al., 2009 Petcovic et al., 2014). This field experience is immersive and multi-sensory, involving a range of physical and mental constructs (e.g., Orion and Hofstein, 1994; Kastens et al., 2009; Riggs et al., 2009; Stokes and Boyle, 2009; Feig, 2010). Students spend time in and out of the field area consolidating and interpreting new material, as well as relating this to their existing body of geologic knowledge (e.g., Feig, 2010; Petcovic et al., 2014).

The value of field education is described in many ways in the geoscience education literature. Field education serves to teach content knowledge by building on classroom learning, through experiencing real world features that are not otherwise accessible (e.g., Lonergan and Andresen, 1988; Gold et al., 1991; Manning et al., 1998; Fuller et al., 2006; Petcovic et al., 2014). In the field, students learn both technical (e.g., observation, data collection) and transferrable skills (e.g., teamwork, metacognition) (e.g., Lonergan and Andresen, 1988; Gold et al., 1991; Manning et al., 1998; Fuller et al., 2006; Petcovic et al., 2014). Geoscientists in training learn to identify features of importance to professional practice (e.g., rock outcrops, contacts, structural features, etc.) and how to communicate and represent these features in the language of geoscience (Kastens et al., 2009; Mogk and Goodwin, 2012). For these reasons, field trips are commonly described as formative experiences in geoscience training (Kastens et al., 2009). They build individual and group identities and form a community of practice (e.g., Gold et al., 1991; Fuller et al., 2006; Mogk and Goodwin, 2012; Petcovic et al., 2014).
Field education is perceived to prepare students for careers or postgraduate study (Manning et al., 1998; Fuller et al., 2006). Although many students will not go on to do bedrock mapping in their careers, employers commonly cite a desire for graduate employees to have general field experience (Whitmeyer et al., 2009; Petcovic et al., 2014) and "attitudes consistent with doing field work" (Jones, 2010, p. 1). Anecdotal data suggest that instructors sometimes use field trips to identify students who hold the knowledge, skills, and interest for the pursuit of future postgraduate studies.

1.2.2 – Challenges of Field Education

Field education is not without limitations, the most widely noted of which are the associated expense and risk of liability (e.g., Gold et al., 1991; Kent et al., 1997; Manning et al., 1998; Boyle et al., 2007; Pyle, 2009; Whitmeyer and Mogk, 2009; Petcovic et al., 2014). External factors such as accreditation bodies and government regulations influence the way that field education is conducted (e.g., Boyle et al., 2009; Whitmeyer and Mogk, 2009). Changes in employment practices, such as recent technological developments, have brought GPS, GIS, and 3D visualisation to the forefront of the essential field skillset (De Paor and Whitmeyer, 2009). Shifts away from mapping-based geoscience careers, as well as the recent decline of the mining and petroleum industries, may have contributed to a decrease in the perceived importance of bedrock mapping (e.g., Whitmeyer and Mogk, 2009; Whitmeyer et al., 2009; Petcovic et al., 2014). Even if bedrock mapping is no longer considered essential, fieldwork is still widely perceived to be a fundamental requirement (Petcovic et al., 2014). Although there is a strong emphasis placed on fieldwork in the geosciences, not everyone enjoys these experiences and the idea of the field may be discouraging to some (Petcovic et al., 2014). Many students are anxious before going into the field for the first time; however, most no longer feel this way at the end of the field trip (Boyle et al., 2007; Stokes and Boyle, 2009). Anxiety may be minimised by providing students with more preparation and information about what the field experience will be like prior to the trip, thereby reducing novelty space, or stresses on their cognitive load dealing with the unfamiliar (Orion and Hofstein, 1994). The following paragraphs describe two examples of people who are at higher risk of marginalisation in the field.

Previous research has found that women were more likely to experience feelings of anxiety before a field trip; however, this was no longer the case by the end of the field trip (Boyle et al., 2007; Stokes and Boyle, 2009). Women were more likely to describe themselves as unfit before a trip and exhausted afterwards (Maguire, 1998). Men indicated that they were unlikely to admit when they found things physically strenuous, worrying that they may be perceived as a burden (Maguire, 1998). These experiences suggest that to some extent, the field is a masculinist environment (Nairn, 1996; Nairn 2003).

The physical nature of the field has immediate ramifications for persons with disabilities, even in the face of legislation supporting equity in education (e.g., Nairn, 1999; Hall et al., 2004; Boyle et al., 2009; Atchison and Feig, 2011). Social and mental barriers, e.g., exclusion and removal from familiar environments and support networks, are further deterrents to equal participation (e.g., Hall et al., 2004; Gilley et al., 2015). Students with disabilities describe concerns about field trips before even enrolling in them (e.g., Hall and Healey, 2005; Gilley et al., 2015). Encouragingly, recent research has shown improvements in inclusivity in traditional field environments (e.g., Gilley et al., 2015; Hendricks et al., 2017) and virtual environments (e.g., Atchison and Feig, 2011).

1.2.3 – Styles of Field Education

Field trips in geoscience range from day/weekend trips through to multi-month (summer) field courses/camps (Gold et al., 1991; Whitmeyer et al., 2009). Lonergan and Andresen (1988) characterised the practical variations of geography field trips with respect to three factors: travel distance, time spent, and availability of educational activities. They described five combinations of these factors: limited travel/limited time (labs, campus fieldwork, day trips), limited activity/extended travel (informally referred to as 'roadside' trips in geology), extended travel/extended time (mapping trips with limited sites, residential field camps), multi-location activities (travel between states or countries, study tours), and learner-practitioner and participant observation (conducted as a part of the community being researched). Kent et al. (1997) caution that though limited activity/extended travel (roadside) trips may require less preparation time, they need extra care in ensuring the learning environment encourages active participation. Extended travel/extended time (mapping) trips require more preparation time, but may result in more enriching learning experiences if students are afforded an appropriate amount of autonomy (Gold et al., 1991; Kent et al., 1997). Field trip styles and the student experience are compared in more detail in Chapter 2, and student autonomy is considered in Chapters 2, 3 and 4.

In increasingly common instances, geoscience fieldwork is being conducted in far away locations (e.g, Nairn et al., 2000; McGuinness and Simm, 2005). McGuinness and Simm (2005) identify many possible reasons for this: (1) increasing globalisation of society, (2) decreasing cost of air travel, and (3) the increasing number of young people that travel. Another contributing factor may be that field camps are commonly required to graduate with a geoscience degree, but field camps are not offered at all institutions, particularly in the United States (Whitmeyer et al., 2009). If students are looking outside of their university or state, they may be compelled to look further afield. This, combined with the fact that travel is a common reason people choose to study geoscience (LaDue and Pacheco, 2013), likely makes overseas field camps and study abroad programmes appealing options for students. Differences in study abroad and local students, and the implication of these on curriculum adaptation are further discussed in Chapter 4.

1.2.3.1 – Health and safety in the field

In the field, unique and sometimes unexpected variables, such as, weather, injuries, sicknesses, and vehicle troubles, become more relevant and impactful than they do in the classroom (e.g., Manning et al., 1998; Fuller et al., 2003; Stokes and Boyle, 2009). Changes in any of these variables may disrupt the curriculum and it is critical to develop comprehensive health and safety plans for each field trip (e.g., Lonergan and Andresen, 1988; Kent et al., 1997; Manning et al., 1998). A lack of familiarity with how to deal with weather conditions, or how to effectively manage these whilst completing assessed work, may increase demands on students' cognitive load (Orion and Hofstein, 1994). Health and safety plans, alongside flexible curricula and resilient instructors (e.g., Fuller et al., 2003; Scott et al., 2006), help to manage, minimise, and mitigate potential hazards to student safety, which by extension, are hazards to learning. In New Zealand, all work places require health and safety plans and formal briefings and debriefs (instructors and students), defined under the Health and Safety at Work Act 2015 (MBIE, 2015).

Geoscientists working in the field pay close attention to environmental conditions in their field notes (Muller, 1983), yet researchers in field education seldom mention the environmental conditions on the field trip they are studying. Or, geoscientists may romanticise the environment like other outdoor educators (North, 2015). Stokes and Boyle (2009) note that they were surprised by student frustration over high temperatures in the field, because they were used to students complaining about wind, rain, and cold. Chapter 3 includes an analysis of the impact of variable weather conditions on the research questions.

1.2.4 – Thinking in the Field

1.2.4.1 – Cognitive processes

In order to understand student behaviour and how this relates to field places, considering how students think and reason in the field (the cognitive domain) is a crucial first step. Studies of this nature have received considerable attention in the surge of geoscience field educational research conducted in the last decade. Petcovic et al. (2009) studied geocognition in the field on a broad level. They found that expert mappers spent less time backtracking than novices, and spent more time near significant features. In another study, sensitivity to important geologic features in the landscape correlated strongly with an understanding of the structural geology (Baker and Petcovic, 2016). On the other hand, novice student makes inefficient field traverses, repeatedly visiting the same areas (Riggs et al., 2009). Furthermore, these areas are often of little geologic significance, sometimes even outside of the boundaries of the mapping area (Baker and Petcovic, 2016).

Expert mappers develop mental models to explain their observations, and they were readily able to verbalise these, including indications of certainty (Petcovic et al., 2009). The novice mapper in this study did not develop any model to explain their observations, nor did they practice any hypothesis testing. This is similar to the lower-performing students in Riggs et al.'s (2009) study, who did not systematically test their own hypotheses. Novices tend to be more successful when they cover more ground and can accurately identify features (Baker et al., 2012).

Interestingly, the final interpretations of the expert mappers in Petcovic et al.'s (2009) study were not all the same. Field notes of more experienced students tend to be more unique than those of less experienced students (Dohaney et al., 2015). These ideas of personal interpretation and thinking for one's self are reminiscent of Frodeman's (1996) characterisation of "envisioning the outcrop" – what is described as "poetic envisioning tempered and disciplined by the rigor of science" (p. 417). In other words, geologic mapping is a rigorous process that requires a certain degree of creativity (Kieffer, 2006). Therefore, the final product is in a sense, subjective (Ernst, 2006). This element of creativity and individuality leads naturally on to the importance of emotions, attitudes, and values in geoscience – including how students relate to field places.

1.2.4.2 – Affective processes

Much of the previous geoscience education research on student emotions, attitudes, and values in the field (the affective domain) has focused on enjoyment and interest in the field. Overwhelmingly, these studies have found that students have strong positive feelings about the field (e.g., Kern and Carpenter, 1984; Fuller et al., 2003; Boyle et al., 2007; Dunphy and Spellman, 2009; Stokes and Boyle, 2009), though some begin field trips with feelings of anxiety (Boyle et al., 2007; Stokes and Boyle, 2009). The significance of peer collaboration through groupwork, and the opportunity to build social relationships with both peers and instructors are widely noted by students (e.g., Orion and Hofstein, 1991; Fuller et al., 2000; Fuller et al., 2003; Boyle et al., 2007; Stokes and Boyle, 2009). Several in-depth studies on lived experiences in the field have been conducted. Stokes and Boyle (2009) incorporated observations and interviews to develop a model of factors influencing the student learning experience in the field. Hendricks et al. (2017) compiled a thick descriptive narrative to draw lessons from the experiences of a personal assistant for students with sensory disabilities in the field, noting the importance of spatial placement, communication, and flexibility of the field trip leaders. Feig (2010) characterised student dependence on technology in the field using observations and structured interviews, and found that students struggled with the difference between accuracy and precision. Students equated technology with truth and rarely questioned it.

In another in-depth study on lived experiences in the field, Williams and Semken (2011) conducted observations and semi-structured interviews on place-based field trips for in-service teachers. The authors found that these field trips had a strong impact on engagement and relationships with local places. There is a paucity of other studies addressing lived experiences of geoscience students in the field as they relate to place, thus providing further impetus for the work in this thesis. Before considering this, it is imperative to first understand how all people, not just geoscience students, relate to places anywhere, not just field places. The following section, related to the work in Chapters 2, 3, and 4, serves to synthesise relevant literature on how humans interact and develop connections with their environment.

1.3 – Human-Environment Interactions

Humans have complex interactions with the spaces in which they live, work and play. We are constantly making sense of these spaces, creating places by construing meanings onto them, and this is continually evolving (Tuan, 1977). We do this by constructing reality, through sensation, perception, and conception (Tuan, 1977). Geoscientists are engaged and perplexed by landscapes, investigating features at a range of spatio-temporal scales. These landscapes and features have their own histories of past occupation and environmental change, and we are fortunate to be aware of these changes on such grand timescales. Massey (2005) writes about her interaction with landscape features and increasing awareness of the immensity of it all: "what this geological history tells us is that this 'natural' place to which we appeal for timelessness has of course been (and still is) constantly changing" (p. 133). The concept of sense of place, one that is uniquely geological, underpins the entirety of this thesis. The following is an overview of sense of place and its measurable constructs, along with place-based education and its relevance to geoscience.

1.3.1 – Sense of Place

In this thesis, 'sense of place' is defined as the feelings and meanings that people ascribe to specific localities (e.g., Brandenburg and Carroll, 1995; Williams and Stewart, 1998; Semken and Butler Freeman, 2008). Sense of place is rooted in the "lived consciousness" of that place (Tilley, 1994, p.15), and thus dependent on the individual or group perceiving the phenomena. It is dynamic, a combination unique to the moment and experience at hand (Williams and Stewart, 1998). Therefore, its facets may only be captured as a snapshot, a characterisation of a moment (or moments) in time. Measurement of sense of place centres around two concepts: place attachment (e.g., Shamai, 1991; Giuliani and Feldman, 1993; Hidalgo and Hernández, 2001; Williams and Vaske, 2003; Scannell and Gifford, 2010; Lewicka, 2011) and place meanings (e.g., Young, 1999; Gustafson, 2001; Manzo, 2005). Some of the limitations of the instruments used in this study to measure place attachment and meaning are discussed in Section 5.5 (Future Work).

Early work by Shamai (1991) categorised place attachment along a seven-leveled continuum, from "not having any sense of place" to "sacrifice for a place" (p.349-350). Williams and Vaske (2003), in developing a quantitative measure for place attachment, identify two dimensions of this construct. "Place dependence" refers to the significance of a place in providing the conditions for specific activities and "place identity" refers to the emotional connection made with place that enhance its importance (e.g., Williams and Vaske, 2003; Kyle et al., 2005; Chen et al., 2014). Previous work has shown significant differences in place attachment after two or less visits (Williams and Vaske, 2003; Semken et al., 2009).

Place meanings may take much more diverse forms and are not necessarily positive (Young, 1999), though research tends to focus on the positive meanings attributed to place (Manzo, 2005). Gustafson

(2001) identified three major themes in spontaneous attributions of place meanings given by respondents – self, environment, and others. These themes tend to vary with places of differing scale and are intimately connected. Some additional themes (e.g. distinction, valuation, continuity, and change) were identified by Gustafson (2001) that were extraneous to the self-environment-others model. Previous work has shown richer and more positive attribution of place meanings with more frequent visits to a place (Young, 1999; Semken et al., 2009).

1.3.1.1 – Relevance to geoscience: connection to Earth

As those who study the planet, affinities for and experiences with the Earth are widely identified as drivers of developing interest in geoscience (Levine et al., 2007; Houlton, 2010; Hoisch and Bowie, 2010; LaDue and Pacheco, 2013). van der Hoeven Kraft et al. (2011) incorporated this into their model of the affective domain in the geosciences, with the novel component "connection to Earth". This component begins by addressing people's attitudes and values towards the environment, or ecological worldview (e.g., Stern et al., 1995; Dunlap et al., 2000). However, connection to Earth takes this relationship with the environment one step further by recognising the geological context as an important aspect – including connections to aesthetic and place attachment (van der Hoeven Kraft et al., 2011). Alongside motivation and emotion, this framework serves as a meaningful way to situate the significance of sense of place in geoscience.

1.3.2 – Place-Based Education

Place-based education describes pedagogy that is not only experiential and rooted in learning about specific places, but is conscious and critical of the diversity of attachments and meanings in those places, transcending traditional disciplinary boundaries (e.g., Gruenewald, 2003; Stevenson, 2008; Kudryavstev et al., 2012; Semken et al., in press). The relationships between people and places are at the core of place-based education, and research suggests that learning socio-environmental content enhances students' relationships with nature or connection to Earth (e.g., Thomashow, 1995; Kirk and Thomas, 2003; Wandersee and Clary, 2008). Not only is understanding socio-environmental relationships important for enhancing an individuals' connection to Earth, it has ramifications for sustainable development and policy (e.g., Hinchliffe, 1996; Musters et al., 1998; López-Ridaura et al., 2002). Ault, Jr. (2008) refers to this as "reciprocal equity" (p.605) between people and landscapes, and the potential and need for place-based education in Aotearoa/New Zealand has been noted by other researchers (e.g., Penetito, 2009; Duhn, 2012). Certain places may be particularly significant to Māori, as tangata whenua (people of the land), with ancestral ties to the landscapes of Aotearoa (Duhn, 2012). Integrating Māori perspectives in all educational contexts in New Zealand is an important step to respecting differences, building connections with local histories, and supporting fair educational experiences for all people (Penetito, 2009). By recognising Māori knowledge and practice, these educational experiences instil social and environmental values that are bicultural in nature (Duhn, 2012). Gruenewald (2003) exemplifies the need for place-based education when he says, "place-based pedagogies are needed so that the education of citizens might have some direct bearing on the well-being of the social and ecological places people actually inhabit" (p.3).

1.3.2.1 – Applications to geoscience

A common goal of field education to is to impart an appreciation or value of the environment (e.g., Lonergan and Andresen, 1988; Gold et al., 1991; Manning et al, 1998). Thus, the significance of place-based education to geoscience has been recognised by several researchers, most notably in two special issues of the *Journal of Geoscience Education* (Apple et al., 2014a; Apple et al., 2014b) and an upcoming review (Semken et al., in press). Furthermore, potential and success in incorporating indigenous knowledge into geoscience field teaching through place-based education has been described by many workers (e.g., Semken and Morgan, 1997; Riggs, 2005; Semken, 2005; Semken and Brandt, 2010; Lemus et al., 2014; Johnson et al., 2014). Despite this, field pedagogies, particularly geologic mapping-based pedagogies, do not necessarily make sense of place and socio-environmental perspectives transparent. This thesis addresses how sense of place and other aspects of the student experience in the field are shaped when pedagogies are not intentionally place-based, yet by their very nature intimately involve places.

1.4 – Specific Research Questions and Thesis Overview

With the overarching goal of understanding the experiences of students as they relate to sense of place in a variety of geoscience field trips, more specific research questions for each chapter are indicated below (Table 1.1). Figure 1.0 summarises the areas of research in each chapter, including: field trip variables studied (pedagogy/structure, changing instructors and weather, student nationality/programme of study), affective aspects discussed (motivation, ecological worldview, sense of place, teaching and learning perceptions), study population (students, instructors), and methods used (quantitative, qualitative, mixed-methods).

Table 1.1: Thesis aims and research questions for each chapter.

Chapter	Thesis Aims	Chapter Research Questions
Chapter 2: Comparison of Roadside and Situated Field Trips	(1) To uncover the nature of the development of sense of place in undergraduate geoscience students in the field (2) To illustrate how the development of sense of place is impacted by differences in field trips or students	(1) How do different types of field trips impact students' place attachment? (2) How does sense of place relate to perceptions of learning on the two differing field modules? (3) Are student perceptions of learning and instructor intentions aligned on the two differing field modules? (a) How does this relate to sense of place?
Chapter 3: Resilience of Field Trips to Differing Instructors and Weather Conditions	(1) To uncover the nature of the development of sense of place in undergraduate geoscience students in the field (2) To illustrate how the development of sense of place is impacted by differences in field trips or students	How do (1) differing instructors and (2) variable weather conditions impact sense of place and the student field experience?
Chapter 4: Comparison of Study Abroad and Local Students	(2) To illustrate how the development of sense of place is impacted by differences in field trips or students (3) To understand how sense of place relates to motivation and environmental attitudes	What affective similarities and differences exist in (1) motivation and (2) connection to Earth between US study abroad students and local NZ students?

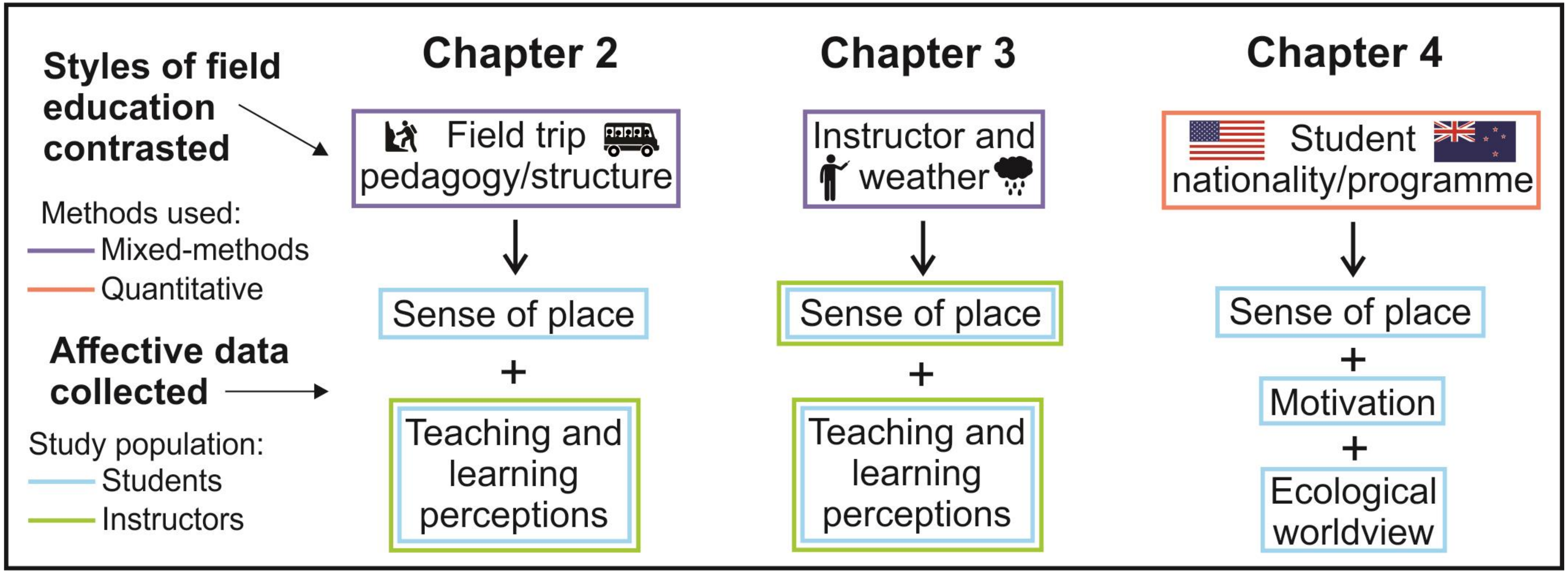

Figure 1.0: Overview of investigations reported on in each thesis chapter.

PREFACE (CHAPTER 2)

This chapter presents a comparison of specific student outcomes on two modules of a geoscience study abroad field camp for American students in New Zealand (Figure 2.0). Distinct pedagogical approaches were taken to each module. The first module was of a 'situated' style – mapping-based in a single site. The second was of a 'roadside' style – smaller exercises in multiple discrete sites. These approaches are common to geoscience field trips worldwide, each utilised for different learning objectives and geological scales of investigation.

Findings illustrate the importance of student autonomy, immersive landscapes, and alignment of student perceptions of learning with instructor intentions. These and other key concepts identified in the mixed-methods analysis are incorporated into a schematic model of each field trip type, along with recommendations to improve student connections with place and engagement with roadside-style field trips. Recommendations are useful not only to educators of the specific field trips where the research was conducted, but to anyone leading roadside-style field trips, in geoscience or other field-based disciplines.

Chapter 2 is currently in review with *Geosphere*.

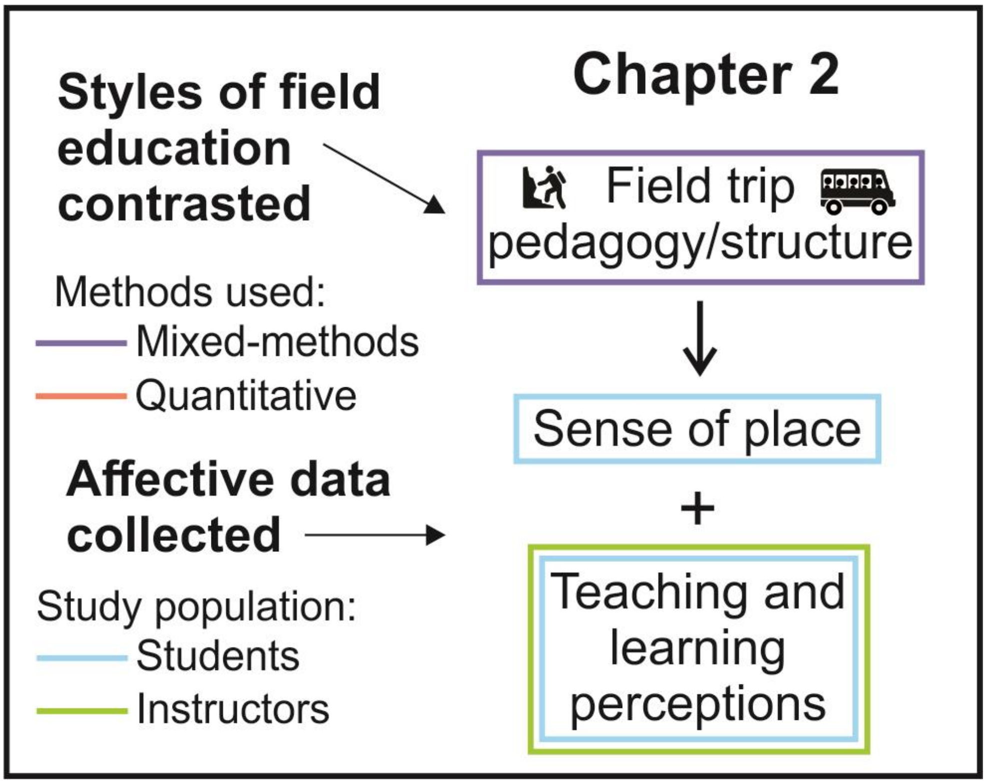

Figure 2.0: Overview of investigation reported on in Chapter 2.

CHAPTER 2: ARE WE THERE YET? SENSE OF PLACE AND THE STUDENT EXPERIENCE ON ROADSIDE AND SITUATED GEOLOGY FIELD TRIPS

2.1 – Research Context

2.1.1 – Field Education: Benefits and Styles

Field trips are widely used in geoscience education around the globe and in several other disciplines, including geography (e.g., Gold et al., 1991; Fuller, 2006), biology (e.g., Smith, 2004; Anderson et al., 2009), archaeology (e.g., Colley, 2003), and in-service teacher training (e.g., Crawford, 2007; Wee et al., 2007; Luera and Murray, 2016). In geoscience, field education is valued for its broad development of knowledge, skills, and scientific/professional identities (e.g., Boyle et al., 2007; Kastens et al., 2009; Whitmeyer et al., 2009; Feig, 2010; Petcovic et al., 2014). Fieldwork is often used to market particular courses or programs of study (Fuller, 2012). Previous research in field education is vast, covering topics such as technology in the field (e.g., De Paor and Whitmeyer, 2009; Feig, 2010), expert-like mapping traits (e.g., Petcovic et al., 2009; Riggs et al., 2009; Dohaney et al., 2015), building multi- and interdisciplinary connections (e.g., Barrett et al., 2004; Anderson and Miskimins, 2006), and access and inclusion (e.g., Atchison and Feig, 2011; Gilley et al., 2015). Much like the vast pool of research on field education, pedagogical approaches to field trips vary widely. Field trips in geoscience range from day/weekend trips through to multi-month (summer) field courses/camps (Whitmeyer et al., 2009). Some instructors opt to maximise diversity of sites visited, while others maximise time spent in a single area (Lonergan and Andresen, 1988; Gold et al., 1991). Lonergan and Andresen (1988) characterised the practical variations of geography field trips with respect to three factors: travel distance, time spent, and availability of educational activities. They described five combinations of these factors: limited travel/limited time (labs, campus fieldwork, day trips), limited activity/extended travel (roadside trips), extended travel/extended time (mapping trips with limited sites, residential field camps), multi-location activities (travel between states or countries, study tours), and learner-practitioner and participant observation (conducted as a part of that community). Field trips that involve more extended activities tend to promote more student-centred learning (e.g., O'Neill and McMahon, 2005; Baeten et al., 2010) and may more easily incorporate project-based (e.g., Blumenfeld et al., 1991; DeWaters et al., 2014) or problem-based learning approaches (e.g., Kahn and O'Rourke, 2004; Charlton-Perez, 2013).

Field educational environments are complex, where variables unique to the non-classroom setting become important (e.g., inclement weather, injuries, or accidents; Stokes and Boyle, 2009). Any unexpected change in trip variables might result in a field trip changing from an extended time/extended travel trip to a limited activity/extended travel trip. Such influences in the field increase demands on students' cognitive load (Orion and Hofstein, 1994; Boyle et al., 2007) and strengthen the need for a thorough consideration of the affective domain (attitudes, emotions, and values) when researching field education.

2.1.2 – The Importance of the Affective Domain in Field Education

Discussions in the geoscience education literature often focus on the cognitive domain, or what students know. The affective domain, or why they learn, is not as widely studied in geoscience (e.g., Boyle et al., 2007; Stokes and Boyle, 2009; McConnell and van der Hoeven Kraft, 2011; van der Hoeven Kraft et al., 2011; Jolley et al., 2012, LaDue and Pacheco, 2013). It can help us understand why students study geology in the first place and why they remain studying it (van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013). Previous work on the affective experience in earth science suggests that students have largely positive feelings towards field education before the trip and these feelings become significantly more positive after the trip has finished (Boyle et al., 2007). Some negative affective responses are apparent at the beginning of field trips and anxiety about the unknown tends to be common (Boyle et al., 2007). However, these negative affective responses disappear by the end of a field trip (Boyle et al., 2007). Students appreciate the importance of field education, value its group work components, and enjoy being challenged in the field (Boyle et al., 2007). Subsequent work by Stokes and Boyle (2009) further supports these findings, and highlights the importance the affective domain has in promoting deep approaches to learning. Deep learning describes learning for understanding, as opposed to surface learning, or rote memorisation (Marton and Säljo, 1984; Trigwell and Prosser, 1991).

Motivation in part determines student approaches to learning, by driving the why and how behind these processes (e.g., Bandura, 1977; Dweck, 1986; Deci et al., 1991; Eccles and Wigfield, 2002; Entwistle and Smith 2002; Deci and Ryan, 2008). Through their self-determination theory for motivation, Deci et al. (1991) identified three needs that influence student desire to achieve certain learning outcomes: 1) competence, 2) relatedness, and 3) autonomy. These factors are all relevant in the field and may be impacted variably by differing styles of field trips. Feelings of competence are dependent upon whether students feel prepared for and/or anxious about the field trip, which may be a particular challenge at the beginning of a field trip (Orion and Hofstein, 1991; Boyle et al., 2007; Stokes and Boyle, 2009). Fieldwork has considerable opportunities to develop a sense of relatedness and community, as students tend to bond with their peers and instructors more readily when in close quarters and social barriers have been reduced (e.g., Gold et al., 1991; Fuller, 2006; Stokes and Boyle, 2009). Student autonomy varies with style of trip and therefore, differing instructor input in the field (Lonergan and Andresen, 1988; Gold et al., 1991).

Students who are intrinsically motivated are driven by their own interest or desire to understand (Deci et al., 1991). More intrinsically motivated students have greater conceptual understanding (Grolnick and Ryan, 1987) and are more positive about, satisfied with and persistent with their learning (Vallerand and Bissonnette, 1992) than students with lower intrinsic motivation. More intrinsically motivated students have also been shown to hold increased interest and enjoyment in their learning (Benware and Deci, 1984). It could be argued that an engagement with geoscience and the Earth is the ultimate goal of geoscience education experiences, fostering an interest and drive to learn more and become better at self-regulation of learning, independent of a particular topic or instructor.

2.1.3 – Sense of Place in the Field

In proposing a new framework for the affective domain in the geosciences, van der Hoeven Kraft et al. (2011) defined a component unique to our discipline, termed “Connections with Earth” (p.72). This component describes the possible ways that people relate to the Earth, including appreciation, wonder, values, and aesthetic. It is based upon theoretical and experimental findings, and intersects with peoples’ motivation and emotions. The authors cite a previous session at the 2008 Geological

Society of America (GSA) Annual Meeting, ‘The Human Connection with Planet Earth: What is it and Why is it Important?’ when they describe this characteristic as “essential for our well-being” and “part of our motivation for learning geoscience” (p.74). They also suggest that harnessing or strengthening a student’s connections with Earth may increase their desire to learn geoscience content.

The connections with Earth component is grounded in previous environmental psychology work on ‘sense of place’ (van der Hoeven Kraft et al., 2011), a term originating from human geography that describes a person’s connections with a place through their attachment to and meanings they see within it (e.g., Tuan, 1977; Brandenburg and Carroll, 1995; Williams and Stewart, 1998; Semken and Butler Freeman, 2008). Our perceptions of places are built upon past experiences and evolve through new interactions, which are sometimes shared with others (e.g., Tuan, 1977; Gustafson, 2001; Massey, 2005; Chen et al., 2014). Imagined through a geological lens and coupled with a cultural lens, each landscape carries with it a heritage of past occupation and environmental change, and it is through the interplay between each individual and each landscape that a new sense of place is formed. ‘Place attachment’ is one component of sense of place (e.g., Giuliani and Feldman, 1993; Hidalgo and Hernández, 2001; Williams and Vaske, 2003; Hernández et al., 2007; Scannell and Gifford, 2010) and is at the interface of connections with Earth and emotion in the affective framework for the geosciences (van der Hoeven Kraft et al., 2011). Place attachment is comprised largely, but not exclusively, of the degree of dependence on and identity with a locality (e.g., Williams and Vaske, 2003; Kyle et al., 2005; Chen et al., 2014).

Successful attempts to address place-based geoscience have been highlighted in recent papers (e.g., Riggs, 2005; Semken, 2005; Semken and Butler Freeman, 2008; Williams and Semken, 2011; Monet and Greene, 2012), including a *Journal of Geoscience Education* Special Issue (“Teaching in the Context of Culture and Place”, 2014). Many geoscience fieldtrips are not explicitly place-based, where specific attention is given to the diversity of cultural meanings of the landscape in question (e.g., place names, environmental issues, indigenous knowledge). Place-based or not, geoscience students in the field are introduced to a range of disciplinary and instructor perspectives of the area that they are in. Students inherently develop their own perspectives on the field place, even if this is not a part of the intended field trip curriculum. They leave the field area often with strong, long-lasting memories of the place, and some even revisit it. Prior work suggests that attachment to natural and recreational areas correlates with pro-environmental or environmentally responsible general behaviours (e.g., Vaske and Kobrin, 2001; Halpenny, 2010). Furthermore, prior experience with a place correlates with sensitivity to environmental impacts on that specific location (White et al., 2008). These connections may be useful not only in graduating students who are environmentally aware and considerate, but also to strengthen their intrinsic motivation for learning about the geology and earth system of a particular place.

2.1.4 – Research Questions

This study analyses two week-long modules of a six-week New Zealand geology field camp for undergraduate students from the United States of America, with a New Zealand based study abroad company, Frontiers Abroad Aotearoa Ltd (Dohaney, 2013; Hampton et al., 2015). The first module is mapping-based around a single site ('situated') and the second addresses independent tasks and skills at several geographically disperse sites ('roadside'). Neither of these modules are explicitly place-based. Under consideration here is the sense of place that develops on field trips which have not intentionally addressed place; however, are inherently grounded in place by asking students to study the landscapes around them. Following the links between the affective domain, sense of place, and fieldwork, this study focuses on several research questions:

(1) How do different types of field trips impact students' place attachment?

(2) How does sense of place relate to perceptions of learning on the two differing field modules?

(3) Are student perceptions of learning and instructor intentions aligned on the two differing field modules?

    (a) How does this relate to sense of place?

2.2 – Methods

2.2.1 – Research Setting

2.2.1.1 – Study participants

Students on the field camp were in their third year of post-secondary study; however, their previous experience with geology and geologic fieldwork varied greatly, as they came from a variety of colleges and universities (see Table 2.1 for a detailed demographic breakdown). The predominant reasons students gave for enrolling in the field camp were its geologically comprehensive nature (covering all rock types in a variety of settings), the ability to fulfill a field camp requirement at their home institution and combine it with a semester study abroad, the desire to travel somewhere new, and the reputation of New Zealand's field geology.

Table 2.1: Demographics of student participants.

Characteristic	Variable	Trip n (total=25)	%	Situated Interview n (total=5)	Roadside Interview n (total=5)
Gender	Female	17	68	2	2
	Male	8	32	3	3
Age	20	17	68	4	3
	21	7	28	1	2
	22	1	4	0	0
Ethnicity	Caucasian	22	88	5	3
	Asian	1	4	0	1
	Declined to Answer	2	8	0	1
Major	Geology	14	56	3	2
	Geology & Other Science*	7	28	2	1
	Environmental Geoscience	2	8	0	1
	Geology & Other Non-Science	2	8	0	1
Number of Geology Field Trips Previously Attended	0	1	4	0	0
	1-2	10	40	1	5
	3-4	10	40	4	0
	5+	4	16	0	0
* includes Geochemistry and Geophysics majors.					

Students were taught by different instructors throughout the field camp, to ensure that they were introduced to many geological sciences faculty and postgraduate students that they would encounter throughout their study abroad semester at the University of Canterbury (UC) in Christchurch. The instructors for the first module (situated) were specialists in: 1) structural geology (lecturer), 2) paleoseismology (PhD student), and 3) regional tectonics and terrane analysis (lecturer). The latter instructor was on the trip in an advisory capacity and had less direct involvement in the module pedagogy than the former two instructors. For this reason, this instructor (regional tectonics and terrane analysis) was not included in this study. The instructors for the second module (roadside) were specialists in: 1) volcanology (lecturer), 2) metamorphic petrology and tectono-stratigraphy (research scientist), 3) active tectonics and tectonic geomorphology (lecturer), and 4) mineral textures and crustal history (visiting lecturer).

2.2.1.2 – Field camp curriculum

The Frontiers Abroad (FA) field camp curriculum is comprised of five modules in five different locations, two of which are considered here (Hampton et al., 2015; Figure 2.1). Each of these modules has a different goal and geological focus, with a general progression from introductory navigation and mapping through to conducting independent mapping and research (Hampton et al., 2015). This study was conducted during modules 2 and 3, at Cass and Westport, both on the South Island of New Zealand (Figure 2.2).

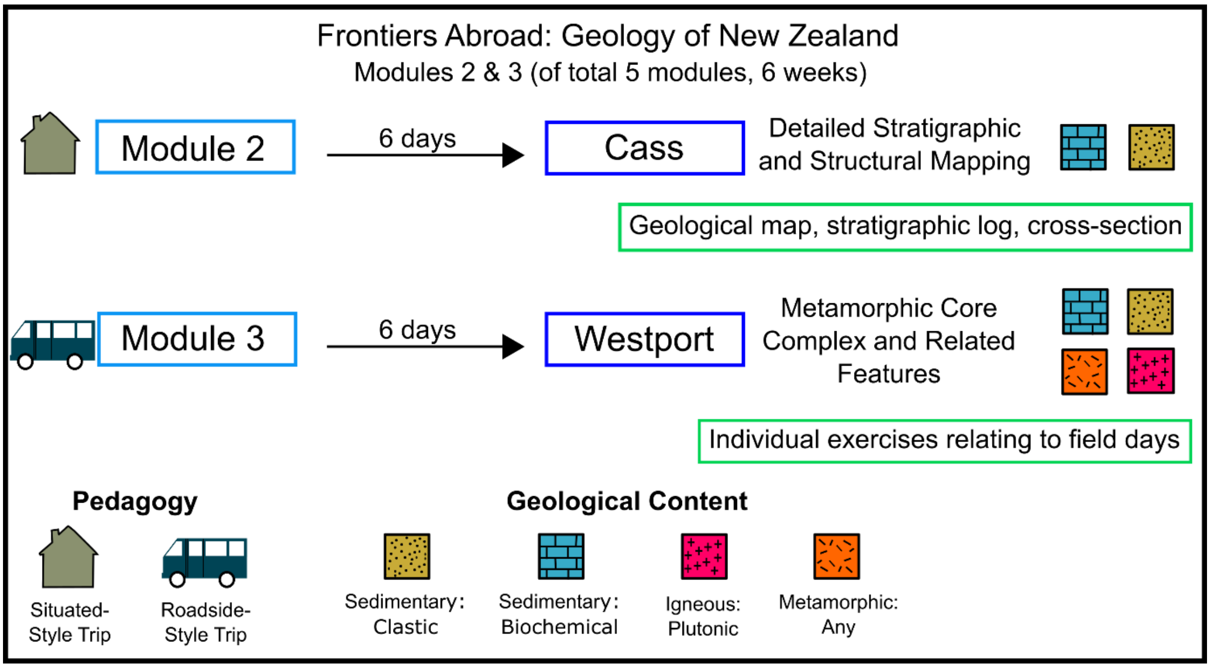

Figure 2.1: Frontiers Abroad field camp curriculum. Only modules referred to in this study are included.

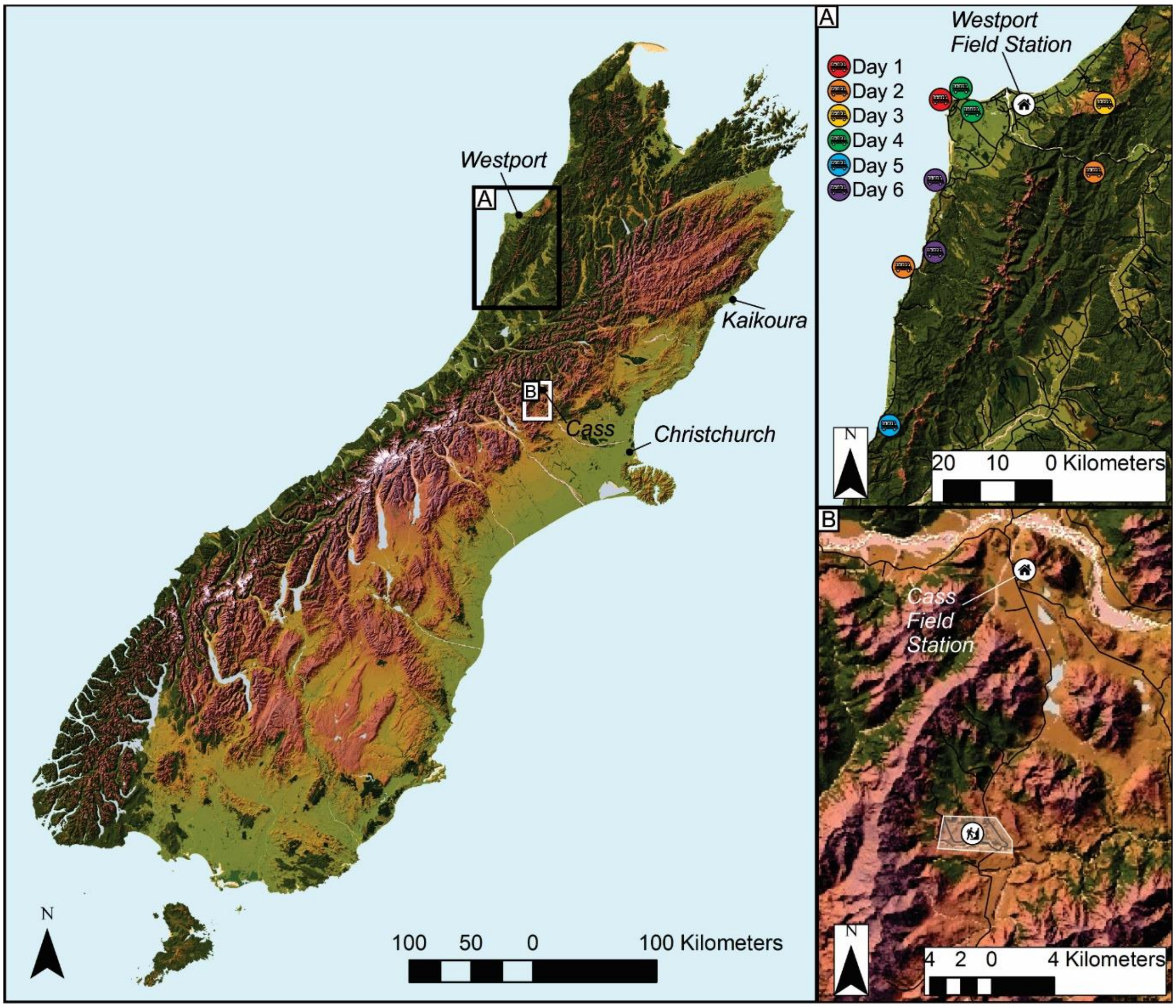

Figure 2.2: Map of field module locations and sites (A, Roadside; B, Situated), South Island, New Zealand. The roadside module contained nine geographically disperse sites visited over six days, whereas the situated module concentrated on one discrete mapping area over the same timeframe.

The field locations both have established field stations owned and maintained by UC, for use in teaching and research. Each has comfortable bunks, a large commercial kitchen, running water, power, heating, and (semi-reliable) wireless internet. The Cass field station is only five minutes from a major highway and rail line, yet in a town with a permanent population of one. It is nestled within the Southern Alps and feels almost completely isolated. The situated-style module taught in the Castle Hill Basin focuses on detailed geologic mapping of sedimentary sequences in a single, discrete area approximately a 30-minute drive from the field station (trip parameters are highlighted in Table 2.2). Students compile a detailed stratigraphic log, map geological contacts, structures, and geomorphology, and prepare geological cross-sections (Figure 2.1). These assessments are completed individually, but students work in mapping groups of three to four (Table 2.2), collecting data and discussing possible explanations and interpretations together.

Table 2.2: Field module parameters: situated vs. roadside.

Characteristics of field module	**Situated**	**Roadside**
Approx. distance from previous location	279 km / 3.5 hours	222 km / 3 hours
Approx. average daily travel time	60 minutes	75 minutes
Max. daily travel time	60 minutes	150 minutes
Number of field sites	1	9
Approx. size of field area	8 km^2	500 km^2
Number of teaching staff	3 instructors, 2 TAs	4 instructors, 2 TAs
Size of peer groups	3-4	12-13 or 25
Assessment tasks	Geological map, stratigraphic log, cross-section	Individual exercises relating to field days (observation, recording, interpretation)

In contrast, the Westport field station is in the middle of a small coastal town suburb; in fact, the suburb was built around it. The roadside-style module focuses on strengthening observational and data collection skills and developing research questions (Figure 2.1). The field sites visited are spread both north and south of the field station and the group visited up to two sites in one day, driving a maximum of 75 minutes each way (Table 2.2). Sites typically involve one rock type; however, lithology and structure vary between outcrops at each site. These lithologies span the range of sedimentary, igneous, and metamorphic rocks and sequences (Figure 2.1). Students complete a number of small assessments relating to field days and sites, though not all sites have a required assessment. Though students do collaborate when working back at the field station, these exercises are much more individual in nature, as they visit field sites in groups of 10-12 (Table 2.2).

2.2.1.3 – Researcher

The researcher (lead author) accompanied the field trip as a non-participant observer, in order to collect data that would help contextualise survey and interview findings by characterising the field environment. The researcher was unable to answer student questions relating to the geology or assessment. The students were aware that she was a PhD student in Geoscience Education, who focused specifically on field experiences and sense of place. The researcher holds degrees in Geological Sciences and Geoarchaeology, and attended a number of field trips as an undergraduate and postgraduate student. She also has served as a teaching assistant on many field trips around New Zealand, including previous years of the FA programme. The researcher is an expatriate from Canada, and therefore, is able to relate to the students' experiences in cultural unfamiliarity and adjustment upon their arrival in the country.

2.2.2 – Quantitative and Qualitative Measures

This study used a mixed-methods approach to investigate student and instructor place attachment, wider sense of place, and perceptions of teaching and learning. Quantitative survey data (Section 2.2.2.1) provided a concise and broad characterisation of the research population's place attachment. However, the complex and difficult to quantify nature of perceptions meant that there was a richer detail and causation that could only be obtained from qualitative data. A sub-sample of interviews with students and instructors (Section 2.2.2.2) were conducted to uncover how their place attachment fit into their wider sense of place (including place meanings), and how this related to the field learning experience. Field observations (Section 2.2.2.3) were collected by the researcher to understand the field experiences of the research population first hand and contextualise the survey and interview data. The following sub-sections describe in more detail each of these quantitative and qualitative measures.

2.2.2.1 – Place Attachment Inventory

Students (n=23, situated; n=25, roadside; two students did not complete post-surveys on the situated trip and therefore did not have matched pre-post data) and instructors (n=3, situated; n=4, roadside) were surveyed for their attachment to the field area, using the validated Place Attachment Inventory (PAI; developed by Williams and Vaske, 2003 and named by Semken and Butler Freeman, 2008). Students completed surveys before and after each field module and instructors completed only one survey, during the field module. Surveys were completed on paper or digitally, dependent upon their own preference and the reliability of the field station internet at the time. The PAI measures both place identity and place dependence to determine sense of place through landscape value.

The PAI was validated using visitation of recreational landscapes in Colorado, Illinois, and Virginia (Williams and Vaske, 2003). Williams and Vaske (2003) found significant differences between a person's place attachment and them having visited it 0-2 versus 3-6 times, indicating that even a short amount of time in a landscape is enough to foster an attachment with it. Semken et al. (2009) found significant differences only between never having visited a site and having visited it one or more times. The PAI compares the place in question to "other places" anywhere in the world or in their home country, and therefore the respondents' overseas travel experience is of limited relevance. Furthermore, the comparison in this study is a pre- to post-trip comparison of the same students, and therefore, both data sets had the same travel experience. The PAI has been found to be applicable to additional locations throughout the United States and has previously been used in geoscience to evaluate the impact of a place-based introductory geology course (Semken and Butler Freeman, 2008). In this study, place names have been changed to "Cass" and "the Westport field sites" and wording only modified to be grammatically consistent with the plurality of these place names. These names reflect the colloquial terms used for the field area in discussion with the students. "The Westport field sites" concisely refers to the collection of field sites visited on the roadside module to capture the overall experience of the students, rather than their attachment to individual field sites.

The same instrument administered to the student participants was used to measure place attachment of instructors on the field trips. Both the student and instructor data sets were analysed following the methods described by Semken and Butler Freeman (2008). Responses to the 12 statements were scored from 1 to 5 on a Likert scale from strongly disagree to strongly agree, with the negative statement "the things I do at (place name) I would enjoy doing just as much at a similar site" reversed scored. Possible PAI scores range from 0 to 60, with a score of 36 or greater indicating place attachment and less than 36 indicating place aversion.

On the first survey, basic demographic information was collected from the students, including their prior field, work, and outdoor experience, and their reasons for enrolling in the field camp (Table 2.1; see Appendix 3.1 for a list of survey questions). Instructors were asked about their experience leading geoscience and other outdoors courses, prior visits to the field site(s), and interest in teaching that particular field module.

2.2.2.2 – Observations: the field experience

Field observations served to keep a running log of the field trip events and contextualise the survey and interview data. The observations did not follow a set protocol, but rather, took the form of a thick description. Thick description is used widely in ethnography to describe cultural groups, and represents a log of what behaviours happened and where (Geertz, 1973), as well as details, emotions and impacts related to these happenings (Denzin, 1989; Ponterotto, 2006). Similar methods have been used in other studies in geoscience education (e.g., Feig, 2010; Atchison and Feig, 2011). Observations were taken by hand in a field notebook, as the researcher moved throughout the field. These observations were primarily general in nature, however, with specific attention to place attachment (references to the landscape and/or participants' relationships with the field area) and engagement (were participants attentive and did they seem to be interested in their work?).

2.2.2.3 – Interviews: perceptions and philosophies

Interviews were conducted with students and instructors in order to understand in more detail their perceptions of the field trip, the types of information covered on the PAI (field area/sense of place), and the background information provided on the surveys. The interviews were exploratory in nature; however, the analysis (described in more detail below) was organised by research question (Cohen et al., 2007). Student and instructor interview findings were compared where the research question necessitated this (Research Question 3/3a - Are student perceptions of learning and instructor intentions aligned on the two differing field modules? How does this relate to sense of place?).
As it was not feasible to interview all 25 students, purposive sampling (Cohen et al., 2007) was necessary. In this case, a random or a self-selected sample would not have been useful for understanding the extent of a potentially wide range of perceptions of field experiences. Instead, a deliberate sample strategy was enacted, where the researcher (lead author) selected five students who represented differing peer groups and a range of demographic, attitudinal, and aptitude characteristics (Table 2.1). These choices were informed by instructors and TAs who had better knowledge of the

students and their personalities than the researcher and incorporated factors additional to Table 2.1, such as the student's comfort within the field area. The interviews represent the perceptions of this sub-sample and are not generalizable to the overall study population, but are instead used to understand survey responses in greater detail. Five different students were interviewed for each of the two modules. Time constraints and the need to avoid overloading the students meant that some students were not interviewed until at maximum three days following the module. These interviews were semi-structured and conducted in/outside the field station or campsite, away from their instructors and peers. The interviews ran an average of 26 minutes, with a maximum of 38 and a minimum of 17 minutes.

All faculty instructors were interviewed (n=6). Most interviews were conducted in the instructors' office, others via Skype. Interviews were semi-structured and had an average length of 48 minutes, with the longest running 78 minutes and the shortest, 26 minutes. Instructor interviews were completed within the year following the relevant module. As time in the field was limited, it quickly became apparent that priority would need to be shifted to completing student interviews whilst on the field trip. It was expected that instructor perspectives would be much less changeable and time or location sensitive, as their sense of place would be based on a rich collection of experiences in the field landscape constructed over a number of years (Stedman, 2003).

All interviews underwent content analysis (Cohen et al., 2007) using an iterative process of coding and verification. Coding through content analysis serves to reduce large volumes of qualitative data to a smaller list of themes, effectively summarising the responses of (in this case) the interviewees. Coding may be perceived as a subjective process, particularly in cases (such as this study) where cross-coder comparisons are not feasible and dependent on the description and interpretation of the researcher. A more inductive approach was used, in which codes (and therefore, themes) were allowed to emerge from the data, rather than using an *a priori* list of codes, to partly counter for subjectivity. While this approach is more time consuming, it forces the researcher to stay close to the data without any preconceived ideas about findings and themes. Emergent themes were checked in the data for counter-evidence as a second step in establishing trustworthiness of the themes. Themes were also triangulated across the range of quantitative and qualitative data in the study. Coding methods included a mix of *in vivo* (interviewee's exact words), process (actions that the interviewee described), emotion (interviewee's feelings), and evaluative coding (interviewee's values; Saldaña, 2009).

The analysis was constrained to the subset of content relating to the research questions (e.g., Miles and Huberman, 1994; Cohen et al., 2007). For the student interviews, the analysis focused on sense of place in the field area and perceptions of their learning on the field trip (Research Questions 1-3). Instructor interview analysis focused on instructor intent in teaching the field module (Research Question 3). After relevant sections of the interview were identified, a first pass with each dataset revealed emergent codes, sub-codes and categories. Codes represent the initial level of summary data used in the content analysis. Any descriptions or reflections that were more specific or detailed were classified as sub-codes. For example, if an interviewee first said that summiting a hill was a memorable experience for them but then also said that it was memorable because they felt satisfied, the code used (process) could be 'summiting' and the sub-code could be 'felt satisfied' (emotion). Categories were used to group codes (and any associated sub-codes) together to provide a broader summary level. In the example used here, the category could be 'positive memorable experiences'. Following the initial list of codes, sub-codes and categories, a second pass was completed to refine and produce an initial frequency analysis of codes/sub-codes. Lastly, a third pass was done with the refined list of codes/sub-codes, producing a final code frequency. The interview themes described in the following sections are all codes, though are generally discussed by category, i.e., with related codes.

2.3 – Findings

2.3.1 – Survey Findings: Place Attachment

After the situated module, average student place attachment shifted significantly towards the positive (32.4 to 39.7/60; non-parametric paired t-test (Wilcoxon test), $p<0.0001$; Table 2.3). Instructors on the situated module (n=3) had place attachments of 37 and 41 out of a possible 60 (Table 2.4). Contrastingly, there was no significant change in average place attachment of the same students on the roadside module (30.3 to 31.8/60; non-parametric paired t-test (Wilcoxon test), $p=0.71$; Table

2.3). Instructors on the roadside module had place attachments of 38, 43, 44, and 45 out of a possible 60 (Table 2.4).

Table 2.3: Student place attachment results.

Trip type	n	Pre	Post	Shift
Situated	23	32.4 (6.6)	39.7 (7.0)	7.3 (5.3)*
Roadside	25	30.3 (6.8)	31.8 (6.8)	1.5 (6.6)
Note: maximum score of 60, >36 indicates positive (more than neutral) attachment. Standard deviation in parentheses. *non-parametric paired t-test (Wilcoxon test), $p<0.0001$.				

Table 2.4: Instructor place attachment results.

Trip type	n	Instructor 1	Instructor 2	Instructor 3	Instructor 4	Student average (post)
Situated	3	37	41	N.A.	N.A.	40
Roadside	4	38	43	44	45	32
Note: no instructors were the same between the two modules. Maximum score of 60, >36 indicates positive (more than neutral) attachment.						

2.3.2 – Field Observations

Field observations on the situated module confirm that students mapped in small groups and therefore, made group decisions about where to go which were not dictated by the instructor(s). Students also decided what to describe and measure and took their own steps to interpret those data (both individually and as a group). Additional observations showed that the instructors reinforced this ownership by telling them that they were looking forward to seeing what they "create". The direction and feedback that the instructors provided was largely focused on supporting the students so that they could effectively complete the final map, stratigraphic log and cross-section. This assessment required the integration of multiple data sources through interpretation of the field landscape. The instructors also emphasised rock description and recording of observations before jumping to an interpretation or idea. Students responded positively to this pedagogy and assessment, and appeared to be attentive and confident throughout the majority of the module.

On the roadside module, field observations support that tasks at all of the field sites visited were focused heavily on making interpretations through instructor-directed Socratic discussions at each site, a change from the previous module. These interpretations were only sometimes related to the geologic history of the region, despite this being identified as a guiding principle for the module (Table 2.2). Although the goal of understanding the regional geologic history was occasionally reinforced in the field, observations confirm that students did not have an assessment or activity that tied the sites together throughout the region. Furthermore, the trip content was varied and spatial distribution of sites was wide, as was the scale of investigation at each site. The instructors decided where to take the students and helped locate them when the group arrived at each site. Instructors often needed to reinforce the locations of each site multiple times. Students appeared frustrated, under-confident and easily distracted at a number of the field sites, particularly when the purpose and context of that site was unclear and when multiple sites were visited within one field day.

2.3.3 – Interview Findings

2.3.3.1 – Student interviews: situated module

At least three of the five interviewees on the situated module indicated that they appreciated the field area aesthetic and specifically described and noted its dramatic/striking topography.

> *"It was beautiful…and like hiking around and um, like you're kind of looking down at the trail and then you look up and just surrounding you are mountains…it always just strikes me how like you're hiking and you look up and it's like there's no flat land. It's just, everything's kind of coming towards you. Um, which is kind of like dizzying but really awesome." – Situated Student 2*

A number of other themes relating to sense of place were identified in at least two of the interviews on the situated module: familiar with field area aesthetic, "vantage points", geology readily apparent in landscape, "huge" area, "cover a lot of ground", stream crossings (as a minor inconvenience and notable event), field station added to experience, and increased geological understanding deepens feelings. Note that quotations indicate when an interviewee's exact words are used to define a code (*in vivo* coding).

"I mean my perceptions have changed with the greater knowledge that I've gained about it. Like as I, as I understand more about what's been going on in this area, it deepens my feeling of what it is…you sort of get a sense for everything that's going on." – Situated Student 1

One perception of the situated module was mentioned in three interviews: time management. Four other themes were recognised in at least two of the interviews: useful to have stratigraphic context, "figure out the structure of the area", build confidence, and data collection.

"But I think that's maybe another thing that you know, they were trying to help us learn, or show us that we needed to learn, was how to manage your time and manage the locations you want to go to." – Situated Student 3

2.3.3.2 – Student interviews: roadside module

One theme relating to sense of place was consistent in three of the five roadside module interviews: appreciated field area aesthetic.

"On the drive it was just like, the ocean. It was just like staring at the ocean the whole time. And just like marvelling at how large the waves are. 'Cause I've never been in a place where waves are so large." – Roadside Student 1

Other sense of place themes were apparent in at least two of the interviews: unfamiliar landscape, appreciated being in New Zealand, appreciated module geology, novel geology, varied module geology, coastal geological exposure, "the abandoned coal town", and nearby town amenities.

A variety of perceptions of the field trip learning were identified in the five interviews. One of these occurred in three interviews: developing research questions. Five other themes were identified in at least two interviews: "understanding metamorphic core complexes", optical mineralogy, real life examples, field days too long, and lack of own background knowledge.

> *"I think it's been, I mean I don't know, maybe my interpretation is different, but I felt like they're trying to get us to think more openly in the field, or something. And really like take a piece of whatever we're seeing in the trip and like try and pose a question." – Roadside Student 2*

2.3.3.3 – Instructor interviews: situated module

Interviews were conducted with the two situated module instructors involved in the study. Both instructors interviewed indicated that the focus of the module was on building knowledge and skills for a final task (map, cross-section, stratigraphic log), with particular emphasis on developing rock description skills. They also both indicated that they intended to leave students feeling like they had ownership over their in-field decisions and work, and therefore, their learning outcomes.

> *"But the context is they've already learned a few skills in Kaikoura [previous module not discussed in this study] and the purpose of Cass [situated module] is for them to produce this geological map using these skills that they've learned…And to do that you need to do good descriptions of your rock units. And along with the geological map you do a cross-section…the purpose of Cass is to make sure the students have what it takes to do that." – Situated Instructor 2*

Other goals individually mentioned by one of the instructors (but not both) were: apply knowledge previously learned, challenge, engagement, enjoyment, facilitate student-staff interaction, interpretation, mapping, rock identification, and safety.

2.3.3.4 – Instructor interviews: roadside module

The most commonly mentioned intentions for the roadside module (mentioned by three of the four) were teaching the content of the regional geologic history and developing students' interpretation skills.

> *"I'm trying to make sure that they understand the task of collecting observations in the field and recording those and learning how to ask themselves questions…it's really important for them to learn that skill of just collecting hard data by uh, investment of time and effort on the outcrop versus getting the buzz of then interpreting that, in terms of the setting or the geological history of the area." – Roadside Instructor 4*

Other goals mentioned by two of the four instructors were the development of: student autonomy, rock description skills, note-taking skills, observational skills, and learning the content of igneous and metamorphic rocks.

2.4 – Discussion

In this discussion, we aim to use our place attachment survey data, field observations, and student and instructor interviews to address how students develop a sense of place and experience their learning on situated and roadside field trips. We answer this overall aim by addressing our research questions sequentially and concurrently developing a schematic representation of each field module that may be used to guide future field trip development (Figures 2.3 and 2.4).

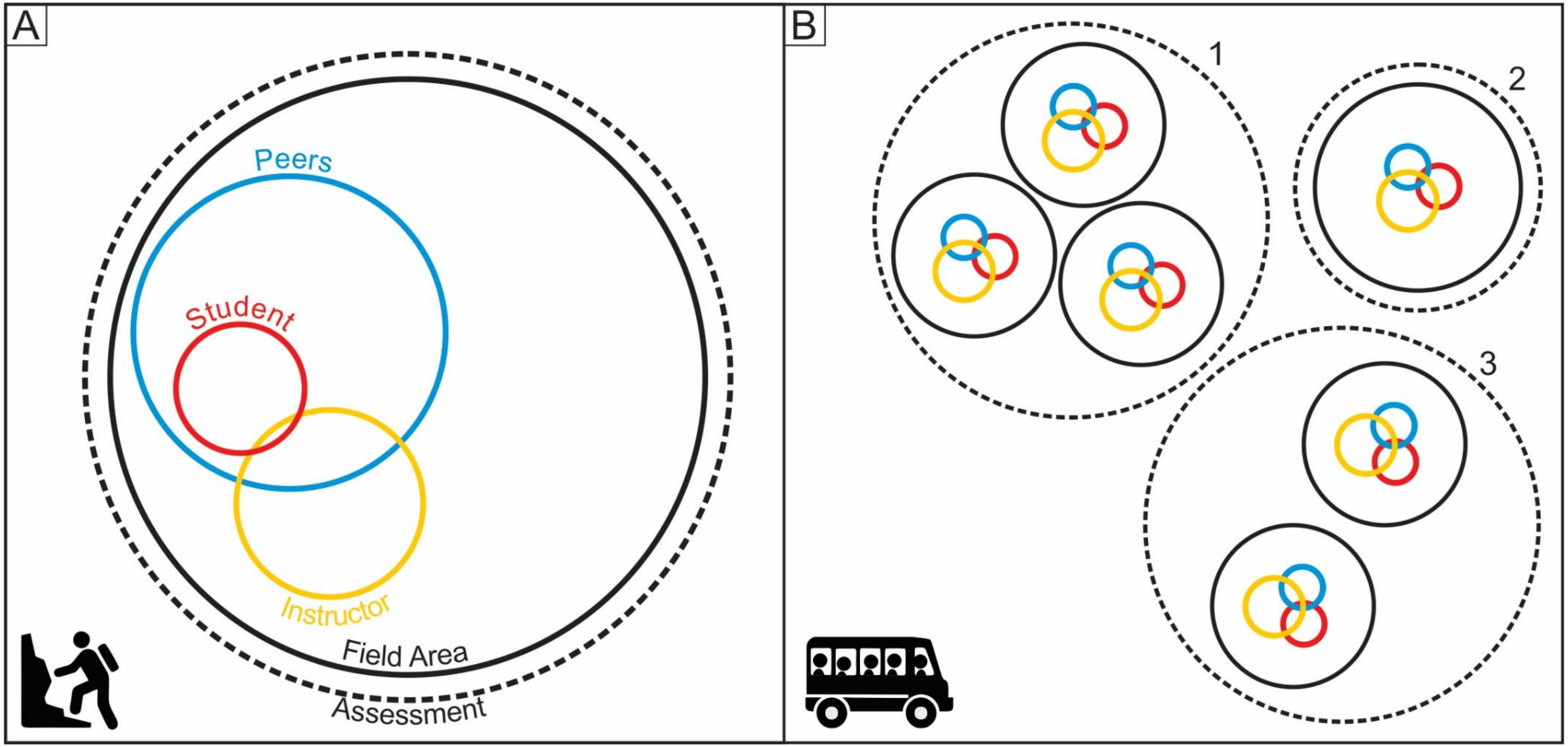

Figure 2.3: Field trip design in this study (A, Situated; B, Roadside). Student, instructor, and peers coloured circle sizes differ to show the amount of input that each group had relative to one another. Note that these sizes and the positioning of each circle are schematic only and not based on quantitative measures. **3A)** Students worked within peer groups and occasionally interacted with instructors. These peer groups worked together towards a unifying assessment constantly situated within the field area. **3B)** Students worked largely individually and occasionally interacted with peers and instructors. Note that instructor input here is relatively larger than in 3B, as the instructors dictated the field plan considerably more in the roadside module than in the situated module, whilst moving students and peers from field site to field site. Students completed smaller assessments that involved either single (e.g., assessment 2) or multiple (e.g., assessments 1 and 3) field sites. However, there was no broader assessment that encapsulated the field area and hence, connected all the discrete field sites together.

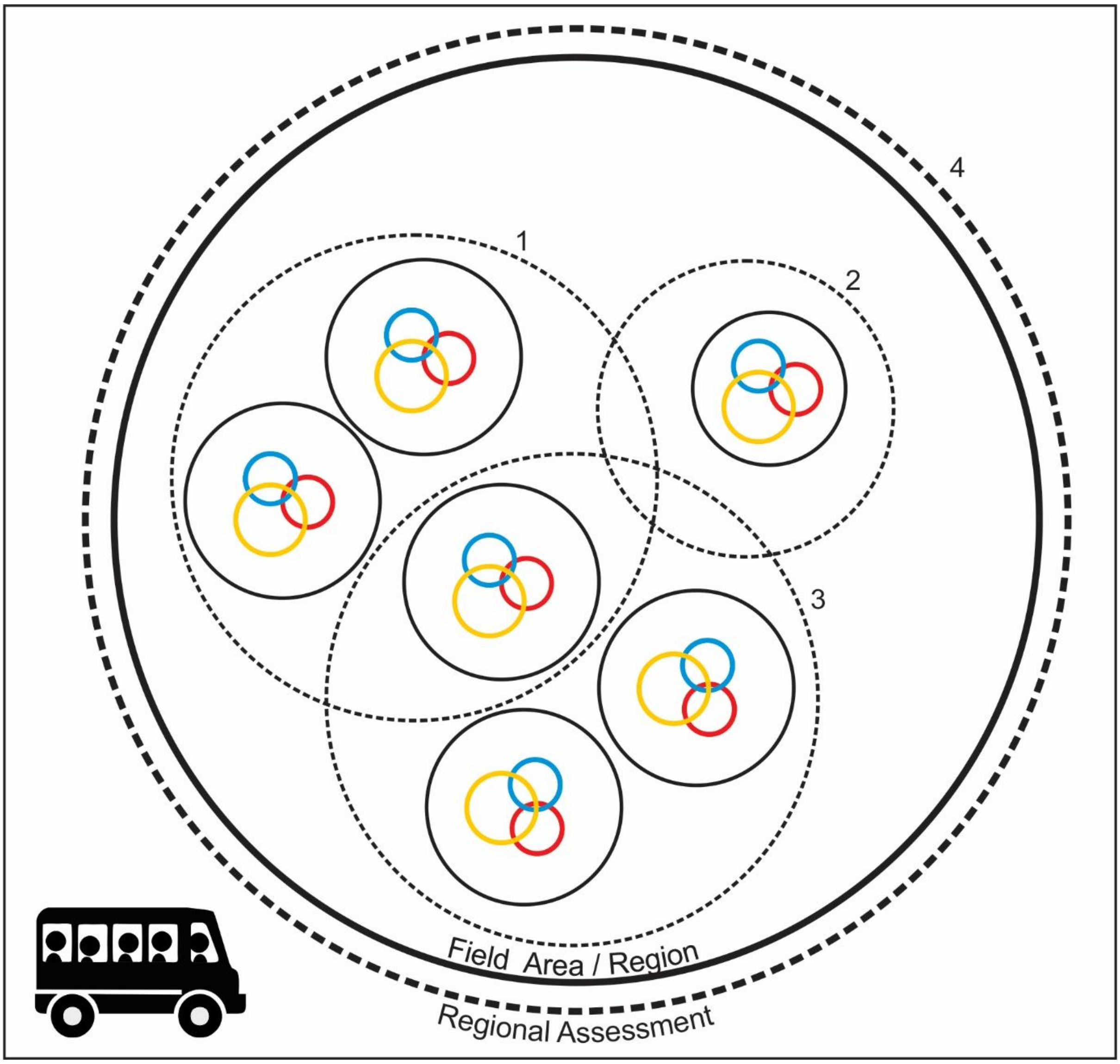

Figure 2.4: Recommended design for roadside field trips. Student, instructor, and peers coloured circle sizes differ to show the amount of input that each group had relative to one another. Note that these sizes and the positioning of each circle are schematic only and not based on quantitative measures. The recommended design for roadside field trips includes: 1) increased interlinking of smaller assessments (e.g., assessments 1-3) and 2) a regional (field area wide) assessment (e.g., assessment 4) which serves to link all field sites and assessments. These recommendations serve to promote greater student place attachment and engagement with the entirety of the field area/region.

2.4.1 – How Do Different Types of Field Trips Impact Students' Place Attachment? (Research Question 1)

Students on the situated module became significantly more attached to the field area, with an average post-trip attachment of 39.7/60. Contrastingly, the same students on the roadside module had no change in their attachment to the field area and averaged a slight aversion to the field sites post-trip (31.8/60). Only the situated module produced an average place attachment higher than that of students in a traditional (non-place-based) introductory geology course (35.3/60; Semken and Butler Freeman, 2008). Roadside trips may need more concerted attention to connecting students to the landscape/field area (Figure 2.3), in order to better foster attachment with these places and strengthen links to the affective domain (Semken and Butler Freeman, 2008; van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013).

2.4.2 – How Does Sense of Place Relate to Perceptions of Learning on the Two Differing Field Modules? (Research Question 2)

The model for the affective domain in the geosciences highlights three concepts that address how motivation and emotion relate to connection to Earth: (1) modeling appreciation, (2) place attachment, and (3) connections to aesthetic (van der Hoeven Kraft et al., 2011). The former (modeling appreciation) is best addressed in the inter-relationships between instructor intent and student perceptions, addressed in the following section (Research Questions 3/3a). The latter two (place attachment and connections to aesthetic) refer to aspects of the student's own sense of place and are relevant to Research Question 2. Findings from interviews and observations are incorporated here to address these concepts and their relationships to student perceptions of learning.

Student interviewees noted that they appreciated the aesthetic of the situated field landscape, its dramatic topography and "vantage points". Some students even remarked that it had a familiar feel to them. These positive feelings were reinforced by the field station setting, which was similar to the aesthetic of the mapping area, despite being 30 minutes' drive away. The field station setting continued the immersive nature of the situated environment.

Previous work has found that a sense of place and appreciation of landscape develops strongly when pedagogy promotes geological inquiry (Ault, Jr., 2014). The structure and assessment of the module allowed considerable opportunity for students to be autonomous, navigate, and make a range of decisions in the field, largely without immediate or constant instructor feedback, and this more project-based approach appeared to promote high levels of engagement from the students. This engagement is consistent with research on student-centred (e.g., O'Neill and McMahon, 2005; Baeten et al., 2010) and project-based learning (e.g., Blumenfeld et al., 1991; DeWaters et al., 2014). The map, cross-section, and stratigraphic log assessments defined the immersive experience of the situated module, and were inherently linked with the landscape by covering the entire field area (Figure 2.3A). Students felt accomplished at mapping an area that seemed "huge" initially, but became more manageable over time as they covered more ground. They described growing feelings of attachment as they understood more about the geology, after only a week of working within that landscape. This illustrates a direct link between the students' own place attachment and their learning about the landscape.

Field observations showed that the roadside structure (multi-site visitation at distances where driving is required) resulted in a more hands-on teaching experience (less student-centred) where students had little autonomy. Students were more reliant on instructors for direction both in physical location and in their own observations and interpretations through Socratic discussions at each field site (Dohaney et al., 2015). Field observations indicated that the students demonstrated less confidence and ownership of their data and work, and this is reinforced by interviewees' worries about their own lack of background knowledge. Though they stated that they enjoyed the varied and novel geology on the module, it was not enough to overcome these worries. Anxiety is common on field trips, particularly at the beginning of the trip or in new environments when students do not know what to expect (Boyle et al., 2007). The structure of the module and observations of the specific assessments confirmed that the concepts studied at discrete sites on the roadside module were not connected through a larger piece of assessment integrating and interpreting the landscape and region through a project-based approach, e.g., a regional geologic map, data summary, or large scale paleogeographic model (Figure 2.3B). Some students reported appreciation of the field area aesthetic and its variety, but this was superseded by their feelings of being spatially disoriented and fatigued when traveling varied and often long distances. Interviewees did not describe feelings of attachment as they did in the situated modules, an important link to the affective domain and student engagement (van der Hoeven Kraft et al., 2011).

Students on the situated module reported forging strong interpersonal connections, particularly in their small (3-4 person) mapping groups. Field observations indicated that students on the roadside module received less support and input from their peers, only occasionally interacting with each other (Figure 2.3B). Group work, or at least autonomous group work, is less practical or necessary at the spatially constrained sites on the roadside module. Fuller (2006) compared an eight-day alpine physical geography extended travel/time trip to a one-day rivers and coasts limited activity/extended travel trip, both in New Zealand. His results suggest that students on limited activity/extended travel trips get to know each other, but that interaction doesn't enhance their engagement with the material (Fuller, 2006). On trips with deliberate group work (e.g., residential field camps), students get to know each other and this social interaction improves their engagement (Fuller, 2006). 'Social learning' has previously been found to be an important component of geoscience field work (Stokes and Boyle, 2009; Streule and Craig, 2016). Interactions with others are also a critical factor in an individual's sense of place development (e.g., Gustafson, 2001; Kyle and Chick, 2007). It is possible that these social interactions and support experiences assisted in developing student sense of place on the situated module in this study.

2.4.3 – Are Student Perceptions of Learning and Instructor Intentions Aligned on the Two Differing Field Modules? How Does This Relate to Sense of Place? (Research Questions 3/3a)

In any curriculum setting, it is important to recognise both the 'intended' curriculum – that which the instructors had planned to deliver (e.g., Porter and Smithson, 2001; Kurz et al., 2009) and the 'received' curriculum – that which occurred in practice and how it was interpreted by the students (e.g., Cuban, 1992; Zamani et al., 2007). These may be compared by mapping the intended learning outcomes onto activities and assessments using the concept of constructive alignment, with the learner's perceptions and experience at the core (Biggs, 1996). Student sense of place may also be impacted by how instructors model their own connections with Earth (van der Hoeven Kraft et al., 2011). Although in our case the instructors did not explicitly address place in their intended curriculum, it was still possible for students to develop a sense of place in their received curriculum. On the situated module, both of the instructors had a positive attachment to the field area. Field observations indicate that all of the instructors on the situated module were focused on helping the students become more capable in the field, particularly towards the completion of their assessment. When asked about their learning on the situated module, students did not remark much on specific content and focused instead on transferrable skills. Time management was the most widely mentioned, and building confidence and data collection skills were also noted. This attention to transferrable skills aligns well with the instructors' self-reported focus on building skills and fostering a sense of ownership in the students. In contrast, there was much less alignment of student perceptions of learning and instructor intent on the roadside module.

Though the four instructors each had a positive attachment to the roadside field sites and they interacted more frequently with the students on the roadside module (Figure 2.3B), students did not perceive the regional connections or importance of these in their learning. Where instructors saw teaching the regional geologic history as a goal, students saw "understanding metamorphic core complexes". This is indicative of the expert ability to see the sites as an interconnected whole (e.g., Bransford et al., 2000), whereas novices see a series of concepts. This awareness of the regional connections across the field area may explain the instructors' considerably higher place attachment to the roadside field sites. Instructors see the (implicit) landscape connections in the roadside module that students only see in the situated module where the connections through assessment are explicit (Figure 2.3). The situated assessment with in-built landscape connections also served as a venue for instructors to model expert-like appreciation and awareness of the landscape. Three students on the roadside module mentioned the conveyed importance of developing research questions, but only one of the four instructors mentioned it. In this case, there is no assessment structure to link the landscape, model appreciation, and help to convey the broader (field area-wide) learning intentions of the instructors (Figure 2.3B). Students were then left to draw their own conclusions not only about how the discrete field sites were connected, but why the instructors had chosen to highlight them.

2.4.4 – Implications of Findings on Further Field Trip Development

The situated field trips in this study had considerable inherent strengths in engaging students with the landscape and its geology, which were further strengthened by its larger, unifying assessment (Figure 2.3A). Students developed a strong sense of place in this environment, even when the curriculum was not explicitly place-based. We can continue to leverage this in field trips of this type by supporting students in being autonomous learners, particularly through curriculum structures that encourage student decision making and exploration. The use of small group work may further support student engagement and connection with the geology by building peer relationships in the field (e.g., Tedesco and Salazar, 2006; Stokes and Boyle, 2009). Additionally, we expect that the introduction of deliberate place-based curriculum through engagement with the cultural landscape to situated field trips will take what is already effective practice in teaching geoscience mapping one step further, and help to create a sense of responsibility for local communities and sustainable geoscience initiatives (e.g., Tedesco and Salazar, 2006; Semken and Brandt, 2010).

There is clearly a time and a place for roadside field trips, and they are designed as such to meet particular goals (Lonergan and Andresen, 1988; Gold et al., 1991), e.g., learning a range of geologic skills, exposure to a diversity of geology, or discovering the regional geologic relationships. However, the discrete field site structure on the roadside trip in this study did not support development of a sense of place or engagement with the field area as a whole, and therefore, its geology. On the roadside trip in this study, students needed to use observations collected on a number of scales to unify complicating dimensions of time, depths and processes through regional frameworks. This created a challenge that was spatially and temporally more expansive than on the situated field trip, particularly when these observations were not explicitly connected through a larger, unifying piece of assessment (Figure 2.3B). We postulate that the use of such regional assessments (e.g., regional map, written geologic history) will help students to develop and maintain a sense of where individual sites fit within the landscape and geologic timescale (Figure 2.4). Assessments such as these will be aided by a concerted effort from the instructors to model appreciation of these connections, and help students develop a sense of place in the field area. We further believe that it is not enough for the instructors to try and convey the wider field relationships, but that students need to discover this for themselves with enough assistance to mitigate anxiety over lack of subject-specific knowledge. Therefore, activities that encourage ownership, independently driven exploration, and a sense of community will be particularly helpful (Benware and Deci, 1984; Deci et al., 1991).

2.4.5 – Limitations

The field educational environment is one that is mentally stimulating and complex. Students experience the need to make complicated decisions and problem solve in physically challenging environments characterised by many intersecting variables, many of which are outside of the instructor’s control (e.g., Boyle et al., 2007; Kastens et al., 2009; Riggs et al., 2009; Feig, 2010; Baker et al., 2012; Hambrick et al., 2012). We have described our setting in detail (Section 2.2.1) and attempted to control for as many of these variables as possible, which are highlighted in the following sub-sections.

2.4.5.1 – Above average student population

The students in this study selected, applied for, and paid for the intensive New Zealand field camp programme, traveling across the world to participate. None of the students had ever visited New Zealand before and were excited to be in a new country where they could see active geological landscapes. The students were possibly more interested, motivated and engaged than the average student studying in their own local area. This does not make the findings less valid, as despite these factors, students had a significant change in attachment on one module and no change on the other. However, overall attachment and potentially, shifts in attachment, may not be as strong on both situated and roadside field trips for differing populations (e.g., non-study abroad students).

2.4.5.2 – Curricular and environmental conditions

Though the students on the two modules were the same, some differences between them could not be controlled for. The situated module is conducted in a mountainous environment, whereas the roadside module is predominantly a coastal landscape, although usually within view of mountains. The two are aesthetically distinct. As mentioned previously, the two modules are taught by an entirely different teaching team. While this was useful for keeping things fresh for the students, it also means that there was some variation between personal teaching styles and beliefs. Finally, the situated module occurred prior to the roadside module, meaning that the students may have been more fatigued for the roadside module, though they did have two days of rest time before beginning it. Regardless of how helpful the rest time was, the roadside experiences were built on the situated experiences, while the situated experiences were built on the students' first module, which was not part of this study. One variable that is undoubtedly out of our control, the weather, was uncharacteristically consistent between the two modules: warm, mostly sunny, with no rain for the two-week duration.

2.4.5.3 – Methodological limitations

Though the researcher's observations were highly useful in providing context and triangulation for the student and instructor populations, it is important to remember that these still require interpretation of the behaviours observed. What the students and instructors are thinking is not always readily apparent, and interpretations are inherently affected by the researcher. All observations were taken by the same researcher (lead author) and therefore, carry with them the same bias, that of a person with largely positive past field experiences as an undergraduate and a fellow North American in a foreign country.

2.5 – Conclusions

This study highlights key differences in two common geology field trip structures: situated (here geological mapping-based) and roadside (here observation/skills-based). This was achieved by contrasting survey, observational, and interview data collected on two, week-long modules of a six-week study abroad field camp to New Zealand, all with the same students. These students had a significant, positive change in their place attachment to the situated field area, but showed no significant change in their place attachment to the roadside field area. Interviews and observations suggest that these differences in student sense of place are linked to perceptions of their own engagement and learning through interrelationships and interactions between the individual student, their peer group, their instructor, and the landscape whilst in the field (Figures 2.3 and 2.4). These interactions helped and hindered the amount of ownership students were encouraged and able to take within these environments, which is also tightly connected to the assessment structure of the module.

The situated trip focused on one mapping, cross-section and stratigraphic log assessment, and required students to make navigational and data collection decisions in small groups of three or four. This occurred whilst being immersed within the same landscape each day, and a similar landscape at the field station, helping to keep the trip connected and students engaged. Students' perceived learning was consistent with instructor intentions of focusing on transferrable skills, rather than specific content.

The roadside trip involved considerable daily travel and a number of smaller assessments. Students had no need to make navigational decisions or work in small peer groups, instead relying more heavily upon the instructors' direction and knowledge. Student perceptions of what they were expected to learn focused heavily on specific content and concepts, whereas instructors described an emphasis on the regional geologic history, showing a mismatch between instructor intentions and student perceptions of learning. Assessment is a concrete way to convey intended learning outcomes to students and reinforce the connections between discrete sites. In order to foster stronger sense of place, affective connections, and therefore, engagement with the wider geological relationships, we recommend that roadside-style field trips be explicitly connected through an assessment structure encompassing all the field sites visited in the field area. Additionally, roadside trips could further be improved by promoting increased ownership and exploration amongst individuals and small peer groups, as well as a sense of community within the students, instructors, and landscape. Further attention to sense of place through incorporation of cultural aspects of both situated and roadside trips may strengthen connections with landscape and result in more environmentally conscious, community-orientated geoscience graduates with stronger intrinsic motivation.

PREFACE (CHAPTER 3)

The previous chapter highlighted inherent strengths in and the importance of student autonomy on situated field trips in developing sense of place and sustaining engagement. Chapter 3 builds on these findings by using multiple streams of a well-established situated field trip in the Department of Geological Sciences to understand how two variables – instructor and weather – impact student outcomes (Figure 3.0). The instructors on the three field trip streams were all familiar with and experienced in teaching in the field area. However, they had differing sense of place and pedagogical approaches. Weather conditions were vastly different on the three field streams, ranging from sun to snow and everywhere in between.

Chapter 3 builds on Chapter 2 by identifying specific aspects of situated field trip instruction that help to foster significant increases in student attachment to the field area. Findings indicate that consistent learning objectives, a carefully selected, immersive, and valued field area, and a (flexible) assessment connected to the landscape are critical for maintaining resilient field trips. These findings are relevant not only to places that run multiple field trip streams within the same academic year, but also those that strive to maintain consistency of student experiences from year to year. Weather conditions are rarely mentioned in field educational research, yet are often casually mentioned to explain highs or lows in student engagement. The characteristics that helped to create similar student experiences on all field trip streams despite particularly trying conditions are important to outdoor educators of any description.

Chapter 3 will be submitted to the *Journal of Geography in Higher Education.*

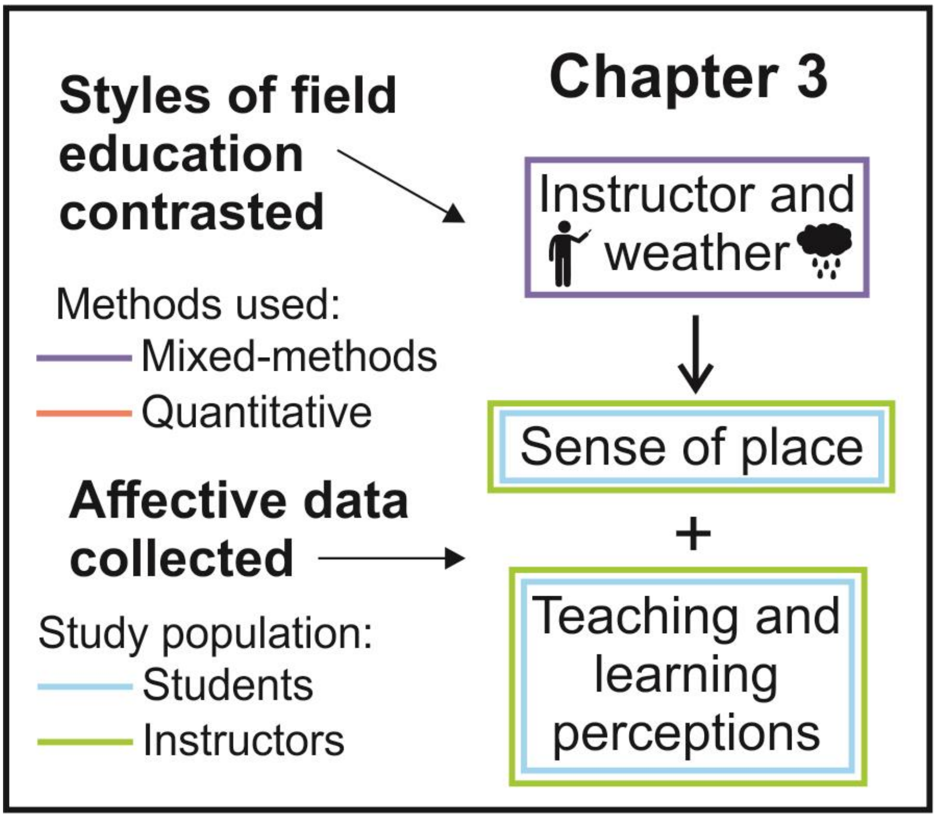

Figure 3.0: Overview of investigation reported on in Chapter 3.

CHAPTER 3: DESIGNING FIELD TRIPS WHERE SENSE OF PLACE AND THE STUDENT EXPERIENCE ARE RESILIENT TO DIFFERING INSTRUCTORS AND VARIABLE WEATHER

3.1 – Research Context

Field education presents an opportunity for students to authentically ground and extend in-class knowledge, resulting in unique and compelling learning experiences (e.g., Boyle et al., 2007; Kastens et al., 2009; Feig, 2010; Petcovic et al., 2014). However, the field is also a complex learning environment, with complicating variables that are absent or less prevalent in classroom environments (e.g., Orion and Hofstein, 1994; Boyle et al., 2007; Stokes and Boyle, 2009). This study seeks to understand the effect of (1) differing instructors and (2) variable weather conditions on sense of place and the student field experience. The following sections detail relevant literature in field trip development, sense of place, and the connections between these.

3.1.1 – Field Trip Design: Logistics, Conditions and Pedagogy

Developing field trips requires considerable effort finding suitable environment(s) and pairing those with desired learning outcomes. Design typically maximises geological characteristics (e.g., appropriate content and level of academic difficulty), along with logistical challenges (e.g., physical exertion and access, accommodation, travel distances) (Lonergan and Andresen, 1988; Gold et al., 1991). The latter are often shaped by health and safety requirements and departmental budgets (Manning et al., 1998; Boyle et al., 2009). Despite the financial and health and safety constraints geologists continue to take students into the field because of its wider benefits (e.g., Kastens et al., 2009; Stokes and Boyle, 2009; Whitmeyer et al., 2009; Petcovic et al, 2014). Other science disciplines that commonly utilise field teaching include archaeology (e.g., Colley, 2003; Aitchison, 2004), biology (e.g., Smith, 2004; Anderson et al., 2009), and geography (e.g., Fuller, 2006; Scott et al., 2006; Boyle et al., 2007; Hope, 2009; Glass, 2015).

Field trips have a reputation for attracting students and may become part of a department's undergraduate legacy. Previous work indicates that 90% of learners/instructors/industry professionals consider fieldwork to be integral to undergraduate programs (Petcovic et al., 2014). In another study, graduating students commonly reported fieldwork as the most positive learning experience in their undergraduate degree (Caulkins, 2009). Field trips, however, are not the same every year and may be complicated by uncontrollable factors, such as weather, tides, and natural hazards (e.g., Scott et al., 2006). Furthermore, instructors change from year to year, or within a particular year if trips are run multiple times. Instructor delivery and emphasis can be variable, even with a set curriculum (Dohaney et al., 2015). Despite changing instructors and weather, the location of the field trip often remains consistent, in order to build staff knowledge, location contacts, and resource repositories (Gold et al., 1991).

Previous work suggests that student connections with the Earth, attachment to particular places, and appreciation of Earth's aesthetic are important concepts for understanding student emotions, attitudes and values and developing their motivation for learning geoscience (van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013). Place-based learning through close attention to local and/or ancestral locations is an effective way to address these concepts, particularly in engaging indigenous communities (e.g., Riggs, 2005; Williams and Semken, 2011). The way the field trip is structured is an important factor in developing student connections with place. Situated field trips foster stronger relationships with the field area than roadside field trips (Chapter 2). The following sections highlight applications of the concept of 'sense of place' to field education.

3.1.2 – Sense of Place: Working Definitions

A wide body of work in disciplines such as human geography, environmental psychology and anthropology described the way that people interact with spaces to form places. As we engage with and learn about our settings, we build our own 'sense of place', or collection of meanings and emotions (e.g., Tuan, 1977; Williams and Stewart, 1998; Gustafson, 2001; Massey, 2005; Semken and Butler Freeman, 2008; Halpenny, 2010). This collection of meanings includes both the natural and the cultural and is bounded by the physical environment (Stedman, 2003). However, meanings are not strictly limited to that place, as the environment may evoke meanings sourced from experiences or memories from elsewhere (Greider and Garkovich, 1994).

‘Place attachment’, one aspect of sense of place, describes the degree of connection a person has with a place (for a review see Lewicka, 2011). Scannell and Gifford (2010) posit that place attachment is comprised of three interlinking agents – the person, the place, and the process (affect, cognition, or behaviour). Place attachment has been applied extensively to the understanding of environmental management, particularly in the realms of recreation and tourism (e.g., Williams and Stewart, 1998; Kyle et al., 2004). Validated survey instruments have been developed for place attachment, which have been widely applied (e.g., Hidalgo and Hernández, 2001; Williams and Vaske, 2003; Kyle et al., 2005; Hernández et al., 2007; Semken and Butler Freeman, 2008). Past analysis of place attachment scores and correlation of these with interview findings have shown them to be sensitive to differing field trip conditions (Chapter 2).

3.1.3 – People in Field Trip Places: Self, Others, and Environment

Sense of place is highly applicable to fieldwork, as immersion in a landscape generates enhanced attention to one’s environment (Lee and Ingold, 2006). This may be further accentuated by walking with others, creating a shared rhythm and experience, potentially helping to bond individuals to one another and the place (Lee and Ingold, 2006). The social nature of field education, with peer and instructor interactions, is important to student field experiences (Kent et al., 1997; Boyle et al., 2007; Stokes and Boyle, 2009; Petcovic et al., 2014; Streule and Craig, 2016).

These ideas echo broader notions of how sense of place is formed, through the connections between self, others, and environment (Gustafson, 2001). Student experiences in the field environment involve several key characteristics: a) themselves, their peers/their instructors (*others*), b) the assessment task they are given, and c) the field area (*environment*; Figure 3.1; Chapter 2). This work will focus two components: instructors (*others*) and weather conditions (*environment*), described in more detail below.

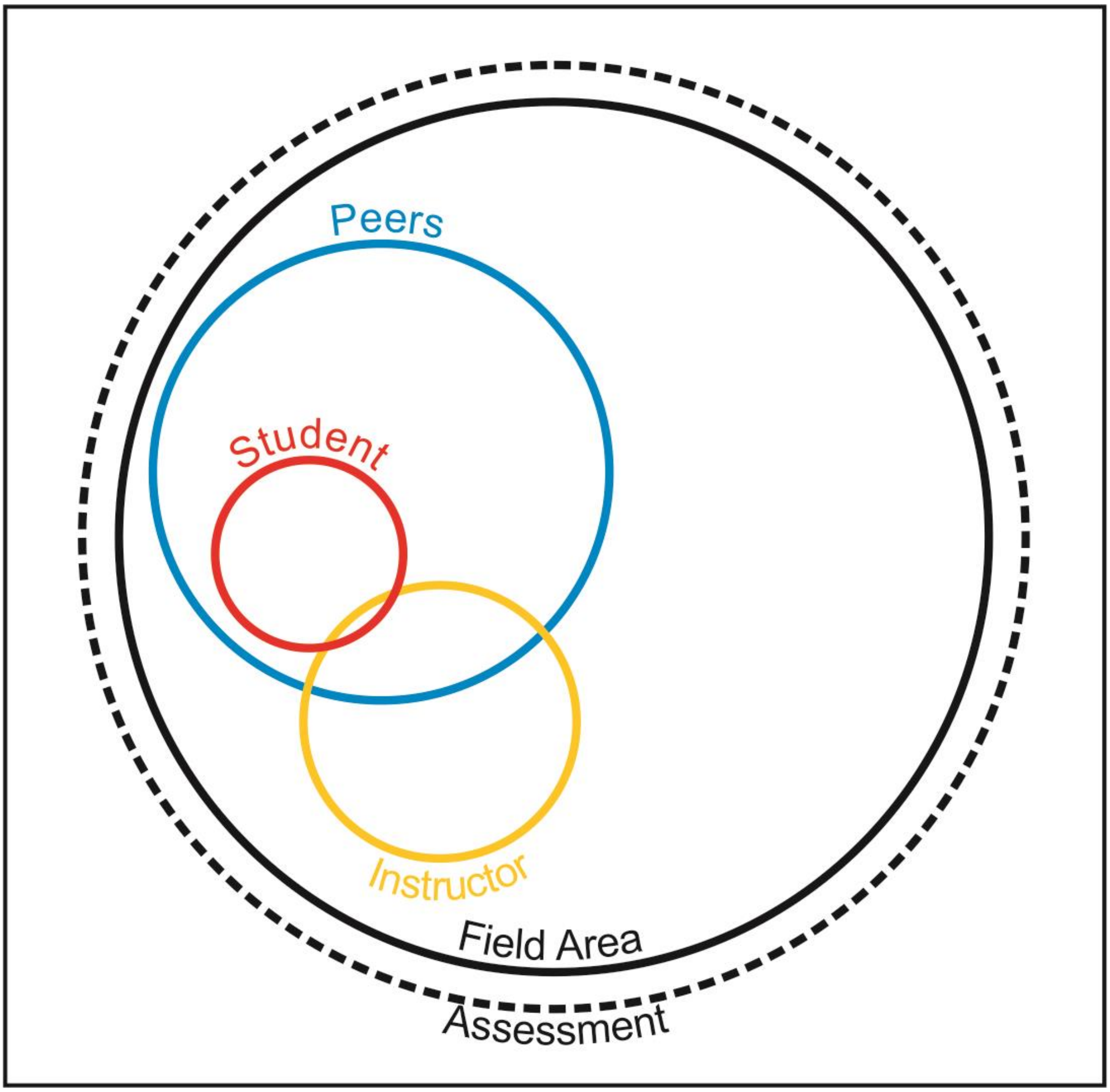

Figure 3.1: Conceptual model of situated field trip design, showing the relative input of an individual student, their peers, and their instructors (Chapter 2). Students operate within their peer groups and all groups are situated within the field area through a field area-wide assessment.

3.1.3.1 – Others: instructors

Undergraduate field trips are typically bound to the geographic location of the institution. Consequently, field trips may have been designed a considerable time ago and may outlast even the most long-standing staff members. Instructors commonly teach field trips that they haven't designed, or teach outside of their own specialist area. One way to minimise the potential instructional variation on a field trip is to have clear and agreed upon learning outcomes (Lonergan and Andresen, 1988; Higgitt, 1996; Kent et al., 1997). However, differences in the style and emphasis of curriculum delivery is unavoidable, due to differing personality types, teaching and learning philosophies, and instructor backgrounds (Dohaney et al., 2015).

In addition, instructors have their own sense of place for that particular field area, based upon their own experiences and knowledge. Orr (2007) argues that place attachment grows “by stealth” (p.49), and takes time. Williams and Semken (2011) addressed the importance of harnessing the strong sense of place among local teachers. However, teachers do not always have a deeply rooted sense of place in their teaching locale. This is the case, for example, in rural schools where teachers are commonly from urban environments (White and Reid, 2008), or in universities where academics are frequently from elsewhere. Teft (2013) found that a group of expatriate teachers in Cambodia was able to instil a sense of place and an ecological awareness in local students that they took into the field. Teachers achieved these results despite their own differing backgrounds and motivations, as well as not having spent much time in the field landscapes. They were able to do so by leaning on their own value of environmental education whilst leveraging pre-existing student connections with natural features, allowing the students to take ownership and discover their own new knowledge for themselves. Despite these promising findings, none of these works have explicitly addressed specific differences in instructor sense of place and gauged whether or not these have variable impact.

3.1.3.2 – Environment: weather

Weather conditions play an important role on field trips and can severely disrupt the curriculum. Field geologists pay close attention to the conditions in their notebooks (Muller, 1983), with the intent of later utilising their weather notes to recall memories or understand why they may have shortened a field day or taken less thorough notes. Though inclement weather is often touted as a drawback (Lei, 2010), short periods of challenging weather may create a stronger sense of community, accompanied by a sense of resilience or accomplishment (Breunig et al., 2010) and teach the ability to withstand a challenge (Butler and Wilkerson, 2000). However, just because the experience fosters a stronger sense of community does not mean that students necessarily learn more, as the physical environment may cause distractions from the learning outcomes (Dohaney et al., 2015). A lack of familiarity with how to deal with weather conditions, or how to effectively manage these whilst completing assessed work, may increase demands on students' cognitive load (Orion and Hofstein, 1994).

Despite the importance of field education to geoscience (e.g., Kastens et al., 2009; Petcovic et al., 2014), work published on specific field trip pedagogies seldom mentions the weather. What is typically discussed in more general treatments of field pedagogies is the need to plan extensively and keep students safe and happy in variable environmental conditions, through comprehensive health and safety measures (e.g., Lonergan and Andresen, 1988; Kent et al., 1997; Manning et al., 1998). Through past experiences, instructors develop to become resilient and most importantly, flexible. Instructors are typically willing and able to adjust the parameters of their field trip in the face of changing conditions, to the point of completely replacing a field experience with a classroom lesson (Table 3.1; Fuller et al., 2003; Scott et al., 2006). All of these approaches help manage, minimise, and mitigate potential hazards to student safety, which by extension, are hazards to learning.

Table 3.1: Field trip adaptations to inclement weather.

Weather Condition	**Possible Adaptation**
Fair	N/A, trip as planned
Average	Consider possible adaptations, continually revisit these
Worsening	Prepare to shorten field day; Consider potential to reduce amount or expectation of assessment; Advise participants of weather conditions and review individual field plans
Poor	Restrict field area (ideally keep local to accommodation); Terminate or suspend field day; Reduce amount or expectation of assessment
Sustained poor (prior to trip)	Restrict field area; Terminate field trip (implement alternate lesson)
Sustained poor (during trip)	Terminate or suspend field day; Terminate field trip; Reduce amount or expectation of assessment

3.2 – Methods

3.2.1 – Research Setting

This research was conducted on three, six-day, introductory mapping trips (15 days total due to one-day overlaps between trips) for second-year geology majors. These were the students' first overnight field trips and their first time producing their own geological maps showing the distributions of rock types in the area. The field accommodation is located within the mapping area and no driving is required beyond travel to and from the field area from the university on the first and final days.

3.2.1.1 – Field environment

The field area is an approximately 90-minute drive from the University of Canterbury (Christchurch) and is located on an active sheep and beef high country farm, Glens of Tekoa, in the central South Island of New Zealand (Figure 3.2). The university has been teaching in the area for over 65 years (Sevon, 1969). The original research mapping was conducted by geologists from the University of Canterbury (Sevon, 1969; Weaver and Pankhurst, 1991; Tappenden, 2003), making the area part of the Department's legacy.

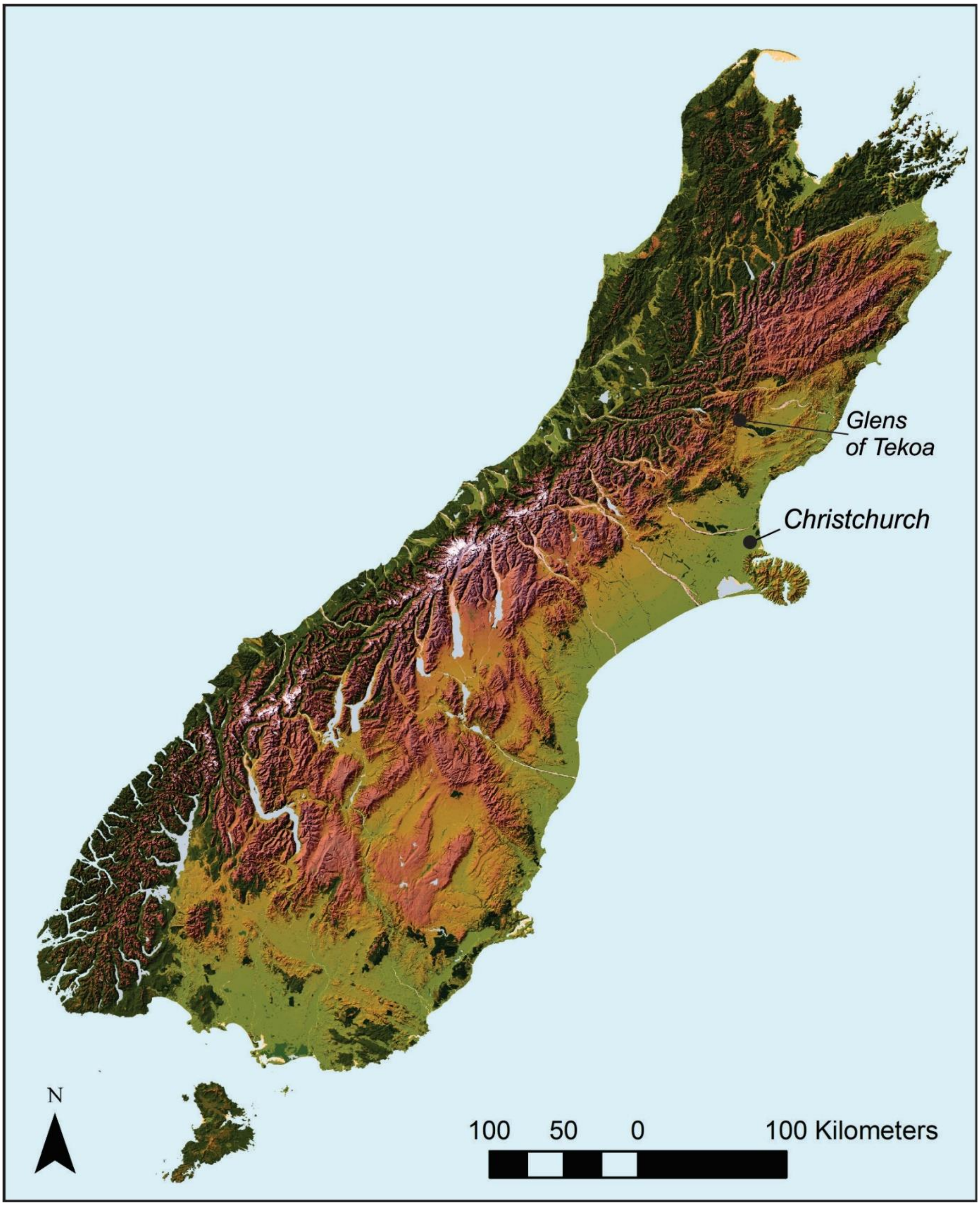

Figure 3.2: Field area location, South Island, New Zealand.

The mapping area contains a variety of rock types (meta-sedimentary basement rock, overlying sedimentary sequence, plutonics, volcaniclastics and volcanics) and reasonably simple structural features (one large fold and some faulting; Sevon, 1969; Weaver and Pankhurst, 1991; Tappenden, 2003). Therefore, the geology is appropriately diverse for an introductory field mapping trip over a small area (4 km^2).

3.2.1.2 – Accommodation

Accommodation is in a series of cottages used to house seasonal farm workers (Figure 3.3). The main building has shared bedrooms, a dining room, and a central living room with an open fireplace. This central living room provides a warm, confined space to work and socialise in, particularly necessary in the unpredictable autumn weather of New Zealand's high country (Figure 3.4). Instructors share the accommodation with the students, reducing social barriers and offering an opportunity for students to get to know their instructors on a personal level (e.g., Gold et al., 1991; Fuller et al., 2006; Stokes and Boyle, 2009). A cook accompanies each field group and provides breakfasts, provisions for packed lunches, and a cooked meal in the evenings.

Figure 3.3: View of the field accommodation (Trip 2), looking WSW.

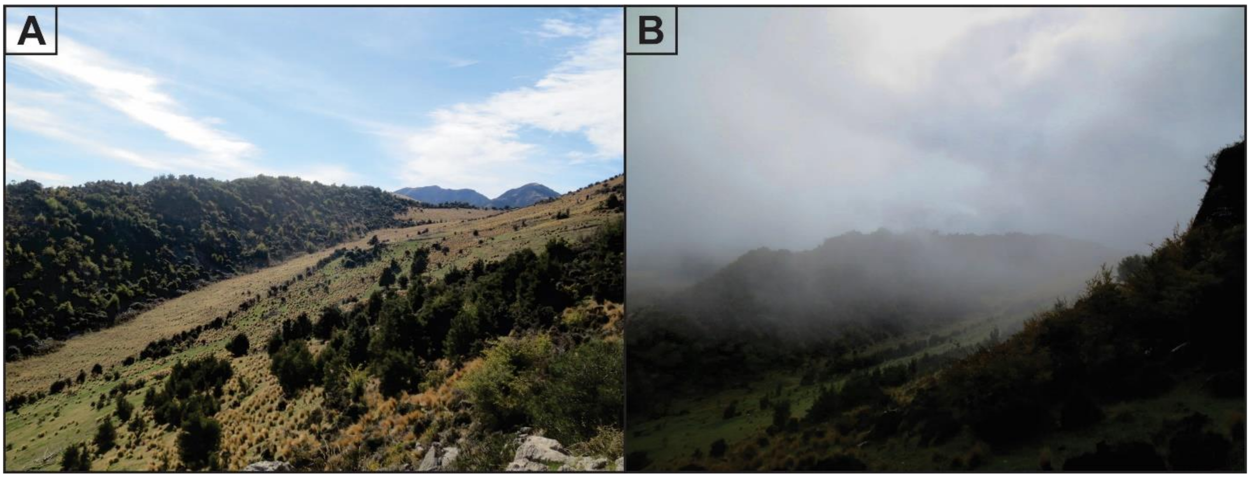

Figure 3.4: Photos showing clear sky (A, Trip 2) and foggy (B, Trip 3) conditions in the field area, looking N.

3.2.1.3 – Pedagogy

The accommodation's size (maximum 23 students) necessitates multiple consecutive field trip streams, each with different instructors. Although the instructors that teach the field trip vary from year to year, the department now has a group of five or six instructors that are experienced with both field teaching and this specific area, even though they have different research specialties.

The assessment is consistent between all trip streams, but instructors tend to emphasise differing aspects given their own specialty and mapping approaches. Instructors are used to having to respond to extreme weather conditions which may impact what is practically possible for the students to achieve given the set timeframe, resulting in minor adjustments to the assessment whilst maintaining learning outcomes. This is explained to students at the start of each trip and helps students avoid worrying about what has happened on other field trip streams.

On the first day, a half day after driving to the field area in the morning, students are introduced to the mapping area and are refreshed on field techniques that they have previously learned in a lab setting (structural measurements, rock descriptions, field notebooks; Table 3.2). It is up to each individual instructor where they would like to take the students and how much of the stratigraphy they want to introduce them to. Each of the three trip streams involved in this study had differing first days (detailed in section 3.3.2 below).

Table 3.2: Field trip itinerary and course level learning objectives.

<table>
<tr><th>Day</th><th>Tasks</th><th>Assessment</th><th>Instructor</th></tr>
<tr><td>1</td><td>Drive to field area (~90 mins.); Refresh of field techniques; Half day guided introduction to field area and rock types (specific locations decided by instructor – see Table 3.4)</td><td>N/A</td><td></td></tr>
<tr><td>2</td><td>Self-directed mapping of smaller inset area</td><td>Inset map and cross-section</td><td></td></tr>
<tr><td>3</td><td>Self-directed mapping of full mapping area</td><td>N/A</td><td>Mark inset map and cross-section, provide constructive feedback</td></tr>
<tr><td>4</td><td>Self-directed mapping of full mapping area</td><td>N/A</td><td></td></tr>
<tr><td>5</td><td>Half day guided traverse through less accessible area (day flexible given weather; Half day self-directed to tie loose ends</td><td>Final map, cross-section, and rock unit descriptions</td><td></td></tr>
<tr><td>6</td><td>Tidy and pack; Return to Christchurch (~90 mins.); Next group arrives (if applicable)</td><td>N/A</td><td>Mark and return maps during following term</td></tr>
<tr><td colspan="4">Students successfully completing this course will:
(1) Be able to observe, record and interpret a variety of geological phenomena in the field.
(2) Be able to systematically record outcrop data, measure basic structural and stratigraphic information.
(3) Be competent to carry out independent mapping and/or field data recording in igneous, metamorphic and sedimentary terrain.
(4) Be able to use aerial photography and contour maps as an aid to field mapping.
(5) Be able to interpret history and extract geological information from geological maps.
(6) Have gained experience orienteering using a map and compass.</td></tr>
</table>

On the second field day, students are given a topographic base map for a <1km^2 area within their larger mapping area that they are expected to fill with their geologic interpretations. They are guided by instructors with suggested routes and key rock exposures (outcrops) to visit, and the recommendation is to get several good structural measurements at these locations, but the students plan their own traverses. When they get back to the field accommodation that night, they refine this map and hand it in to the instructor, along with a cross-section (interpretation of what the rocks look like below the surface), highlighting the major fold structure in the area (Figure 3.5). Students get feedback on this assessment roughly 24 hours after they hand it in, so they are able to incorporate this feedback into their field approaches and final map.

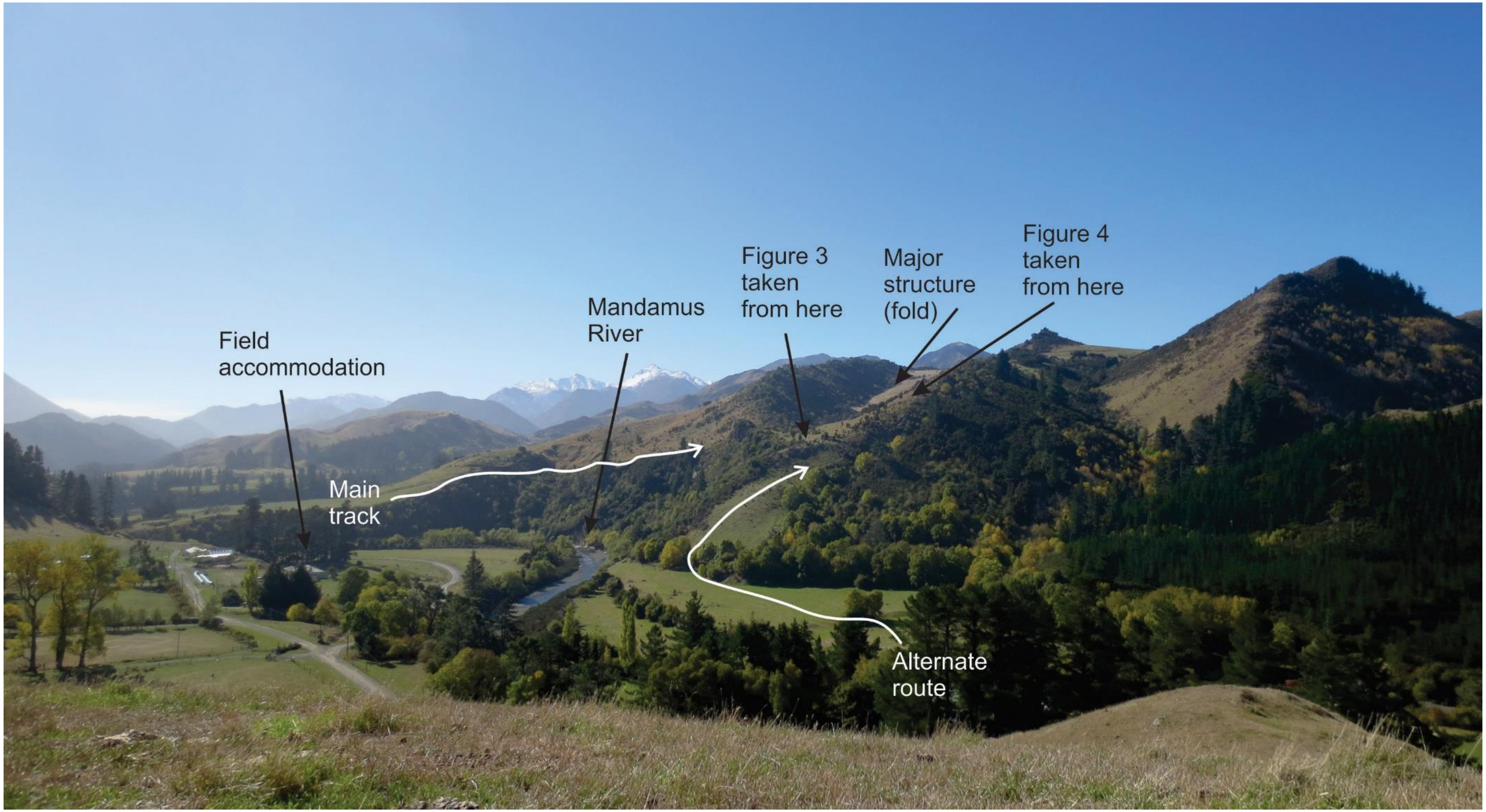

Figure 3.5: Overview photo of half of field area (Trip 2), looking NNE. Note that the ‘alternate route’ requires crossing the Mandamus River, but is more efficient than the ‘main track’.

The students then have three more days to complete the larger 4 km^2 map, cross-section, and rock unit descriptions. Aside from one half day through a less accessible area, these three mapping days are largely student driven, although the students continue to present field plans to their instructors for constructive comment. Instructors ensure that they see each mapping group at least once per day. Students work in self-selected small groups of two to four, allowing them to take ownership of the partnerships that result and the decisions that they collectively make in the field. For most of the students, this is the first significant opportunity they have to acquaint themselves with each other and they tend to form long lasting friendships on this trip. These collegial interactions are further reinforced by the small and unique style of field accommodation.

3.2.2 – Place Attachment Inventory

Students and instructors were surveyed for their place attachment using a validated instrument comprised of 12 statements addressing their degree of dependence on and identification with the field area (Williams and Vaske, 2003). The Place Attachment Inventory (PAI) compares the applicable place to 'other places' elsewhere (developed by Williams and Vaske, 2003 and named by Semken and Butler Freeman, 2008). It was validated with recreational landscapes in the United States and has been found to be sensitive to as little as one visit to an area (Williams and Vaske, 2003; Semken et al., 2009). The PAI has been previously used in geology to measure the impact of classroom and field-based courses (Semken and Butler Freeman, 2008; Chapter 2).

Students completed the survey on paper at the start and end of each field trip stream, so that the impact of the trip could be measured (n=17, 18, 15 on trips 1, 2 and 3, respectively). Instructors completed the same paper survey once during the trip (n=1, 1, 2 on trips 1, 2 and 3, respectively), also on paper. Responses were scored from 1 to 5 on a Likert scale from strongly disagree to strongly agree. Scores were reversed for one statement, "the things I do at (place name) I would enjoy doing just as much at a similar site". Each person's responses were totalled to give a score out of 60.

3.2.3 – In-Field Observations

In order to contextualise other findings and further understand the setting of each field trip stream, the lead author accompanied all of the trips to collect observations. On the first field trip stream, the researcher was accompanied by a field assistant who collected their own observations. These observations were non-participant in nature and the students were advised that the researcher(s) could not be asked questions about the geology. The researcher(s) traversed the field area and made sure to interact with a variety of students throughout each day, as well as observing the way the students perceived and responded to direction they received from instructors. The result was 'thick description' in a narrative style (Geertz, 1973), logged in a field notebook for later analysis.

The field assistant, who had recently taken the field trip as a student, provided additional observations on the first field trip stream and offered a point of comparison, as well as a student perspective for discussion. As the observations were naturalistic and of a thick descriptive nature, inter-observer comparison would not be meaningful in this case. Furthermore, differences in observation were important for perspective and therefore desired.

3.2.4 – Student and Instructor Interviews

Students and instructors were interviewed in a semi-structured format to understand their sense of place and experience on the field trip in more detail. While the questions and topics were pre-determined, the question order and precise wording were not, and follow-up questions were left to the discretion of the researcher (Appendices 3.3 and 3.4).

Interviewees were deliberately selected (n=3 per trip) to represent differing backgrounds, aptitudes, and field mapping groups. The interview findings are not generalizable for the entirety of the study population, but were targeted to represent the variability within it. Interviews were conducted in a private space in the field accommodation at the end of each field trip stream. The student interviews ranged from 8.5 minutes to 30.3 minutes.

Each of the four instructors from the three streams were interviewed post-field trip in a private space on campus. Though Trip 3 was team-taught, the two instructors were interviewed separately to allow each of them time to reflect and share their individual views. The instructor interviews ranged from 32.5 minutes to 62 minutes.

An iterative coding and verification process was used to summarise themes emergent in the responses of the interviewees. Allowing codes and themes to emerge inductively instead of using an *a priori* list of codes reduces tendencies to privilege any preconceived ideas (Miles and Huberman, 1994). Interview data were also triangulated with survey and observational data. Emergent themes were further checked for counter-evidence to help establish trustworthiness. The analysis was confined to interview material that was relevant to the research question of this study (Miles and Huberman, 1994) and focused on perceptions of: field education in general (instructors), intended learning outcomes (instructors) and teaching (students) on this field trip, and the field area and its suitability for this field trip (students and instructors). First, relevant sections of the interviews were identified, followed by a first pass of coding to produce a list of emergent codes and broader categories to group together these codes. This was refined with a second pass and finalised with a third pass and code count. Coding methods included a mixture of *in vivo* (interviewee's exact words), process (actions that the interviewee described), emotion (interviewee's feelings), and evaluative coding (interviewee's values; Saldaña, 2009).

3.3 – Findings

3.3.1 – Variable Weather Conditions

Poor weather conditions not only impact student morale and experience on a broader level, but also impact access in the mapping area. River crossings provide more efficient travel than the rough terrain (Figure 3.5), but may not be crossed if flow is too high. Furthermore, a number of crucial outcrops may be accessed only by wading to the outcrop and getting wet and if badly prepared, cold.

This research was conducted over a particularly varied weather span during April 2015 (Autumn; Table 3.3; Figure 3.4). Trip 1 had the worst weather, including rain, sleet, and snow, and two field days that had to be cut 1-2 hours short because of worsening conditions. Trip 2 was dry, with mostly warm and sunny days. Trip 3 was mixed, with grey, misty days and partly cloudy days.

Table 3.3: Weather conditions at Glens of Tekoa during April 2015.

Trip Number	**Date**	**Maximum Daily Temperature: Culverden (°C)**	**Total Daily Precipitation: Culverden (mm)**	**Average Daily Flow: Hurunui River (cumecs)**
Trip 1	11/4/2015	19	1.6	31
	12/4/2015	14	0.0	32
	13/4/2015	19	0.4	73
	14/4/2015	11	4.2	59
	15/4/2015	9	0.0	49
Trip 2	16/4/2015	13	0.0	42
	17/4/2015	16	0.2	37
	18/4/2015	20	1.8	38
	19/4/2015	15	0.4	35
	20/4/2015	22	0.0	31
Trip 3	21/4/2015	22	1.2	29
	22/4/2015	14	5.4	28
	23/4/2015	15	1.0	27
	24/4/2015	17	0.2	25
	25/4/2015	20	0.0	24
Data courtesy of Environment Canterbury.				

3.3.2 – Instructor Perspectives and Sense of Place

The following sections describe similarities and differences relating to instruction and instructors on each of the field trip streams. Firstly, perspectives relating to the value of and approaches to field education are detailed. Next, intended learning outcomes and differing field itineraries (aspects of instruction specific to this field trip) are described. Finally, instructor place attachment and sense of place with the field area are highlighted.

3.3.2.1 – Instructor perspectives: field education

Interview findings indicate that instructors a) were supportive of field education, b) valued its position within the undergraduate geoscience curriculum and c) believed that it attracted students to the discipline. Instructors attributed the strength of field education to a) providing real life examples in their natural setting/context, b) putting the classroom into practice, and c) developing a sense of learning ownership and independent problem solving in students.

Two instructors mentioned that field education (in particular) helped teach students how to build information up from scratch. One instructor focused on the value of being outside and having a tactile engagement with the landscape. Another described the importance of students learning what they need to bring into the field and experiencing a sense of exploration. Two instructors described approaching field teaching by starting more hands-on, then gradually backing off and providing more opportunities for student autonomy as the trip goes on. Other approaches described were having high expectations and providing a supportive learning environment.

> *"I think part of the beauty about geology is marrying whatever sophisticated models you want to run, or microscope work you want to do, or structural techniques you want to do in the lab, with actually sitting there in the landscape and seeing the rocks in situ…'Cause that's what we're really trying to understand, is the earth. I think field teaching is always gonna be, I mean, field science is always gonna be an important part of that…I think the students love that aspect of geology." – Trip 3 Instructor*

3.3.2.2 – Instructor perspectives: goals and approaches for this field trip

Instructors described their intended goals for this specific field trip. These largely focused on what they called "basic" or "core" elements of field skills: locating yourself, "taking strikes and dips" (structural measurements), and recording observations in order to create a map (Table 3.2). They also described higher order goals of thinking outside the box/creatively, making assumptions and interpretations, and problem solving independently.

"The first one is preparation for field work. And that is, um, locating yourself on a map, taking strikes and dips, recording observations and drawing sketches…It's just doing these things. Practice, practice, practice. And they've got to think outside the box a little bit. It's not simple enough that they can just get away with drawing them on. They've got to think, how are these rocks next to these rocks? They can't get all the answers in the field, they've got to make some assumptions and make some interpretations." – Trip 2 Instructor

Field observations indicate that though the field trip streams had the same assessment structure and mapping area, each instructor incorporated variable levels of student autonomy in their introduction to the field area on the first half day (Table 3.4).

Table 3.4: Day 1 field itineraries as defined by trip instructors.

Trip Number	Field Location (Purpose)				
	1	**2**	**3**	**4**	**5**
1	Farm buildings (locate on base map)	Main track (distal field sketch, note-taking procedures)	Main track cutting, outcrop 1 (rock description, note-taking procedures)	Main track cutting, outcrop 2 (rock description, note-taking procedures)	Outcrop 3 (rock description, geologic contact recognition, unit relationships)
2	Outcrop 4 (locate on base map, distal field sketch, rock description, note-taking procedures)	Ridgeline, multiple outcrops (rock description, structural measurements)	Ridgeline (continued), multiple outcrops (rock description, structural measurements)	Ridgeline (continued), multiple outcrops (rock description, structural measurements)	Ridgeline (continued), multiple outcrops (rock description, structural measurements)
3	Outcrop 5 (locate on base map)	Track 2 cutting, outcrop 6 (rock description, note-taking procedures)	Outcrop 7 (rock description, note-taking procedures)	Outcrop 8 (rock description, note-taking procedures)	Outcrop 9 (rock description, geologic contact recognition, unit relationships)

3.3.2.3 – Instructor sense of place

Instructors on the field trips had place attachment survey scores of 50 (Trip 1), 35 (Trip 2), and 27 and 31 (Trip 3, n=2). These differences were statistically significant (one-way ANOVA, 4 treatments, 12 values per treatment, p=0.003; Table 3.5). In the interviews, instructors described the area as a “pretty ideal field site” which provides a comprehensive “experience” for the students. They did note that other locations would be workable, but thought that this field area was quite special in its variety of geology, including a structural component, in such a small space. However, two of the instructors still wished that there were more rock types in the area that aligned with their own (differing) research specialties. All of the instructors noted that the balance between simplicity and complexity is perfectly suited to the students' academic level.

Table 3.5: Place attachment to Glens of Tekoa.

	Trip 1 (n=17)	**Trip 2 (n=18)**	**Trip 3 (n=15)**	**Significance****
Instructor(s)	50	35	27, 31	Yes, p=0.003
Student Average, Pre (Standard Deviation)	24 (7)	23 (8)	27 (6)	No, p=0.26
Student Average, Post (Standard Deviation)	32 (10)	33 (9)	33 (9)	No, p=0.94
Student Average, Shift (Standard Deviation)	8 (12)*	10 (9)#	6 (6)^	No, p=0.53
Note: results of Wilcoxon matched-pairs signed rank test between pre and post: *p<0.05; ^p<0.01; #p<0.001. **results of one-way ANOVA; was the null hypothesis rejected?				

Interview findings further suggest that the accommodation is a crucial part of the field area. Three instructors noted that it was most important the students stay within the mapping area and can cover the whole area on foot. Two instructors described the need for the students to get along whilst living and working together, and that this is particularly important in such small and rustic quarters. One instructor mentioned the importance of everyone (including instructors) fitting into the same accommodation and being on the same "level".

> *"I guess the one thing about [the location] that probably works, is that you're bringing them back to a small, confined space…And also having the confined spaces with a small group. They've got to get on and they've got to work together." – Trip 1 Instructor*

Two instructors noted each of the following downsides to the field area: a) its private ownership, b) some difficult to identify rocks and c) the potential for poor weather conditions. On several occasions instructors described their willingness to adapt assessment and expectations to the weather conditions. One instructor mentioned the need to ensure that students are comfortable and focused on mapping, and not preoccupied with the weather conditions. At a broader level, all instructors noted the importance of making sure that any student worries were tempered before they became detrimental, or to identify variabilities in student expectations (and the frustration of not being able to do this all at once when they have dispersed in the mapping area).

3.3.3 – Student Perspectives and Sense of Place

The following sections highlight similarities and differences in student findings, particularly with respect to the three field trip streams. Students' field experiences are described, including their perceptions of what they were expected to learn on the field trip. Following this, student sense of place and the relationships of these to their geological learning are detailed.

3.3.3.1 – Student perspectives: the field experience

Eight of the nine students interviewed indicated that they enjoyed the experience of being in the field. Students particularly valued the opportunity to put their data together and build knowledge from the foundation up. Although four students indicated that it was a "drastic change" from the classroom/lab environment, five stated that they felt adequately prepared given the skills they learned in preparatory tutorials. However, three students remarked that the relevance of these skills learned was not apparent until they began working in the field. All but one of the students indicated that learning how to map was a key purpose of the field trip. Other commonly mentioned skills learned were a) rock description/observations, b) note-taking, c) getting good quality data, d) identifying imperfect rocks and e) making interpretations.

> *"Just getting us to like try and get information from the field. Then coming back and trying to put it together…We got back and I put it all down, and then I linked it all up and it made sense." – Trip 2 Student*

At least one student interviewed per trip (four students in total) stated that they found the field days to be long and tiring. All of the students interviewed on Trip 1 stated that the weather conditions were poor, but that they were able to cope with them readily. One of these students noted that the instructor shifted their expectations as the conditions worsened. Only one of the six students interviewed on Trips 2 and 3 (fairer weather) even mentioned the conditions at all. Five students mentioned that getting to know and bonding with their classmates was a significant positive contributor to their field experience. None of the students on Trip 1 referred to this.

3.3.3.2 – Student sense of place

On all field trips, students had a significant increase in their attachment to the field trip location (Table 3.5). There was no significant difference in place attachment between any of the field trips (one-way ANOVA; Table 3.5). Seven of the nine students interviewed said that they liked the field trip location and six said that they thought it was beautiful or scenic. None of the students had spent time in this exact location before, but three indicated that this type of landscape was familiar to them. One student interviewed per trip highlighted the isolation of the field area.

> *"[I'd tell the landowners about] all the rocks and the beauty of it. Um, and just the peacefulness of it. It's just a really stunning, peaceful, tranquil place to be. And um, the way the river cuts through and you've got all the beautiful terraces. It's just lovely." – Trip 3 Student*

Six students (two per trip) noted that the field area was useful for its variety of geology, and in particular, the occurrence of igneous rocks and major fold and fault structures (three students noted each of these). Three students interviewed said that it was appropriate for their academic level (simple, yet complex). Six students did not feel a need to revisit the area, as they had gotten to know it well enough whilst mapping. Seven students described an enhanced appreciation for the landscape after learning about its geology.

[After stating that they were not that impressed with the area when they arrived]

"Yeah, I feel a bit different now about it. But like, I think I just have a lot more appreciation for it. 'Cause I've been out there and I've looked around it." – Trip 1 Student

3.4 – Discussion

Students on each field trip stream had a significant positive increase in their average attachment to the field area after the field trip (Table 3.5), but there were no significant differences between streams. Many similar themes arose in student interviews regardless of field trip stream (e.g., learning how to map, building information from the ground up, an appreciation for the field area and its scenery), despite differences found in instructor place attachment, implementation of the field curriculum, and weather conditions. Our findings suggest that these similarities in student experience and sense of place are due to three characteristics consistent across the field trips: 1) intended learning outcomes (Table 3.2), 2) an immersive field area valued by instructors, and 3) an assessment connected to the landscape/field area with flexibility in its implementation, especially when faced with adverse weather conditions.

3.4.1 – Intended Learning Outcomes: Consistent Between Instructors and Key Ideas Clear to Students

Instructors had differing specialties and field observations indicated that they supported differing levels of autonomy at the beginning of teaching on their respective field trip streams. Despite these differences in instructor and peer input, interview findings highlight the similarities at the core of each instructor's intended curricula, aligned with course level learning objectives (Table 3.2). All instructors believed field education to be crucial for connecting the classroom to real world examples and developing a sense of ownership and ability to independently problem solve in students (Table 3.2, Objectives 1 and 3). These findings are similar to previous work on the perceived importance of field work in the earth sciences (e.g., Fuller et al., 2006; Scott et al., 2006; Petcovic et al., 2014). They are also reminiscent of Teft's (2013) research that indicated the importance of instructor value of environmental education and student ownership and discovery in helping to build a sense of place.

On this field trip, instructors focused on core field skills (Table 3.2, Objectives 1, 2, 4 and 6), thinking outside the box, and making assumptions (geological interpretations; Table 3.2, Objectives 1 and 5). By the end of the trip, instructors on all field trip streams had similar levels of input and allowed for a great deal of autonomy for students and their peer groups (Table 3.2, Objective 3). Observations indicate that instructors made one or more adjustments to their relative level of input (and hence, that of peers and individuals) in response to student progress with assessments and varied weather conditions. Students finished the trip with similar levels of attachment to the field area (Table 3.5). Students consistently described the purpose of the field trip as teaching them "how to map" (Table 3.2, Objectives 3, 4 and 6) and a smaller number highlighted synthesising and interpreting data (Table 3.2, Objective 5). Students did not identify the broader fieldwork connections that other students have mentioned in studies, such as transferrable skills, identity development, or career preparation (e.g., Fuller et al., 2003; Boyle et al., 2007; Petcovic et al., 2014). However, much of this work has focused on later year university students, who have a much broader range of experience than the second-year students involved in this study. The students in this study are on their first bedrock mapping trip and may not yet realise that these skills are applicable beyond mapping (e.g., Table 3.2, Objective 1), nor that field geology is not confined to bedrock mapping. When asked about the 'most important' things that they learned, students in this study identified specific components of mapping, including rock descriptions/observations, note-taking, and collecting good data (Table 3.2, Objectives 1, 2 and 3). Although students may not have perceived the wider implications of field education or why it is strongly valued in geoscience, the learning outcomes of this particular course were clear to them, through the provided learning objectives (Table 3.2) and instructor application of these on the field trip.

3.4.2 – Field Area/Trip Location: Instructor and Student Appreciation Alike

By design, the location of the field trip is the same between streams and findings from the instructor interviews indicate why the location is so valuable for this specific level of field trip. Several important factors were noted by the instructors: 1) the variety of geology and simple structural components of an appropriate academic level, 2) the small field area, and 3) the fact that the groups stay within the field area and 4) the small and unique character of the quarters in which the groups stay. The importance of an immersive field area and an assessment that encompasses it has been previously found to be important for fostering a sense of place and student connections with the geology (Chapter 2). Furthermore, this field area is especially immersive with its lack of external distractions, e.g., no internet/mobile phone reception and no shops within walking distance.

Instructors perceived similar geological values in the landscape, despite their differing attachments to the field area. This represents a distinction between personal feelings for an area and an appreciation for what it offers educationally. Although it may not be a favourite field area of all the instructors, they are aware and appreciative of its geologically important characteristics. This echoes the importance of selecting effective field locations indicated in other works (e.g., Gold et al., 1991; Manning et al., 1997). Perhaps most importantly, the geologically important characteristics identified by the instructors also became clear to their students.

Many of the students interviewed recognised and appreciated the variety of geology in the field area, the structural components, and the simple, yet complex nature of the geological relationships in the area. However, the students did not note the relatively small size of the mapping area, the fact that the group stays within it, or the benefits of staying in close quarters together. This may be because this is their first overnight field experience and they have no other trips to compare it to. However, a number of students did note the fact that they were able to bond with peers and instructors on the field trip, widely consistent with studies of social and cultural factors on field trips (e.g., Boyle et al., 2007; Stokes and Boyle, 2009; Petcovic et al., 2014). The students in this study may just not have realised or agreed with the instructors on the role that the immersive field area played in the social and learning outcomes of the field trip.

3.4.3 – Assessment: Consistent Between Trips, Aligned with Learning Outcomes, and Connected to the Landscape

The assessed small map and cross-section, large map and cross-section, and final rock unit descriptions are the same across all field trip streams. These are well aligned with the teaching of core field skills (Table 3.2, Objectives 1, 2, 4 and 6), as described by the instructors, and the perceived purpose of learning how to map (Table 3.2, Objectives 3, 4 and 6), as described by the students. The map assessment defined and encompassed the field area and provided a direct connection to the landscape. Previous work has showed that a field area-scale assessment, most easily/commonly achieved with a mapping exercise in a situated learning environment, fosters an increased sense of place after finishing a field trip (Chapter 2). This owes largely to the process of getting to know/connecting with the landscape through its geology (in this case) and in a way where students take ownership of this process, through independent investigation (Table 3.2, Objective 3). Students on the field trip have the freedom within their peer group to decide where to go and discover outcrops for themselves, creating a shared experience and peer relationships that help foster place attachment (Lee and Ingold, 2006). On all trips, students described similar feelings of attachment and appreciation for the landscape, having gained an understanding for its geology and an awareness of how it influences topography.

3.4.3.1 – Flexibility to weather conditions: instructor implementation

Of important note to the assessment is its inbuilt flexibility and willingness of instructors to adjust their expectations and pedagogy to mediate adverse weather conditions, consciously or unconsciously. It may also be relevant that students remain within their field area even in poor weather. In field areas where the accommodation is not immersed in the landscape and difficult conditions force the group outside of the area, sense of place may not be as strong, similar to what has been observed on roadside style field trips (Chapter 2).

Although discussion of flexibility to adverse weather only arose in the student interviews for Trip 1, this is the only trip that encountered particularly adverse conditions and therefore the only time where we might expect students to realise its importance. None of the students interviewed felt that the unfavourable weather significantly impacted them and one specifically recognised that the instructor had shifted their expectations. This suggests that the instructor on Trip 1 effectively mitigated the difficult conditions by reducing student autonomy. These findings are similar to those of Boyle et al. (2007) and Stokes and Boyle (2009) who found that after a field trip, students were less likely and no more likely, respectively, to lose interest in their field work because of the weather. However, it is interesting to note that none of the students interviewed on Trip 1 noted the importance of the social elements/peer bonding, whereas five of the six students interviewed on Trips 2 and 3 mentioned it. Work by Breunig et al. (2010) suggests that limited adverse conditions fosters a sense of resilience and community amongst students in the outdoors, but when the adverse conditions are prolonged they detract from the sense of community.

The need to anticipate and adapt to student concerns, including the weather, was described on several occasions in the instructor interviews. Orion and Hofstein (1994) detailed the importance of preparing students for possible weather conditions (among other unfamiliar factors) in order to reduce novelty space and increase their ability to concentrate on their learning. It is clear that this is important not only for safety and potential for learning, but for ensuring that students develop connections with the landscape and geology.

3.4.4 – Limitations

This study was conducted in one field area and over one academic year, so these findings may not be generalizable to all field trips in all locations. However, previous work contrasting situated and roadside field trips suggests that the methods are sensitive to and applicable to two other locations within New Zealand (Chapter 2). Care has been taken to describe the research setting for this field trip so others may interpret how it compares to their own setting.

In-field observations are limited because it is impossible to know everything that the students and instructors are thinking. These limitations are mitigated by triangulating the observations with other data sources. Observations also require a human instrument, the researcher, and therefore carry with them the bias of that instrument. Careful attention has been paid to describing the position of the researcher, who collected observations on all of the field trip streams. The added dataset of a second researcher on Trip 1 also helped to corroborate observations and provide the lead researcher with the context of the student perspective to take forward through the latter two trips.

Student interviews were conducted at the same time on each trip, after their assessed work had been completed. However, just as the poor conditions on Trip 1 restricted the amount of work the students were able to do in the time that they had, it may have also limited the amount of time that they had to reflect on their experience, in comparison to the students on Trips 2 and 3. Alternatively, it may have dominated Trip 1 students' account of the experience. The similarity in interview responses between field trip streams suggests this is unlikely to be the case; however, it may be in part responsible for the lack of perceived importance of the social aspects of the field trip.

3.5 – Conclusion

This study uses place attachment survey data, in-field observations, and student and instructor interviews to compare perceptions of the field experience and development of sense of place on multiple streams of the same introductory geoscience mapping field course. Our findings suggest that all students had largely similar experiences and shifts in place attachment, regardless of field trip stream and associated differences in weather and instruction. We illustrate a conceptual view that the progression in place attachment is affected by the amount of instructor input and hence, student autonomy, determined by differences in pedagogy and/or weather conditions (Figure 3.6). For example, following the hand-in of the first assessment (Table 3.2), the Trip 2 and 3 instructors reduced their input (and increased peer input), to allow for increased student autonomy and promote increased attachment to the field area. At the equivalent time on Trip 1, the instructor increased their input (and decreased peer input) in response to worsening weather conditions, to mitigate a potential decrease in place attachment. Further analysis of in-field observations and student and instructor interviews have helped us identify key characteristics which we believe to be important in ensuring comparable field experiences:

(1) Intended learning outcomes which are consistent between all instructors, as well as clearly communicated and readily apparent to students.

(2) A carefully selected field area that is valued by instructors.

(3) An assessment(s) that is (are) consistent between all field trips, aligned with intended learning outcomes and connected to the landscape (field area).

    (a) An assessment(s) with in-built flexibility and instructor willingness to make minor adaptations in the face of adverse weather conditions.

Following the above guidelines in careful design of field trip curricula will aid in ensuring that student experiences are the same from trip to trip and year to year, regardless of variable instruction and/or weather conditions.

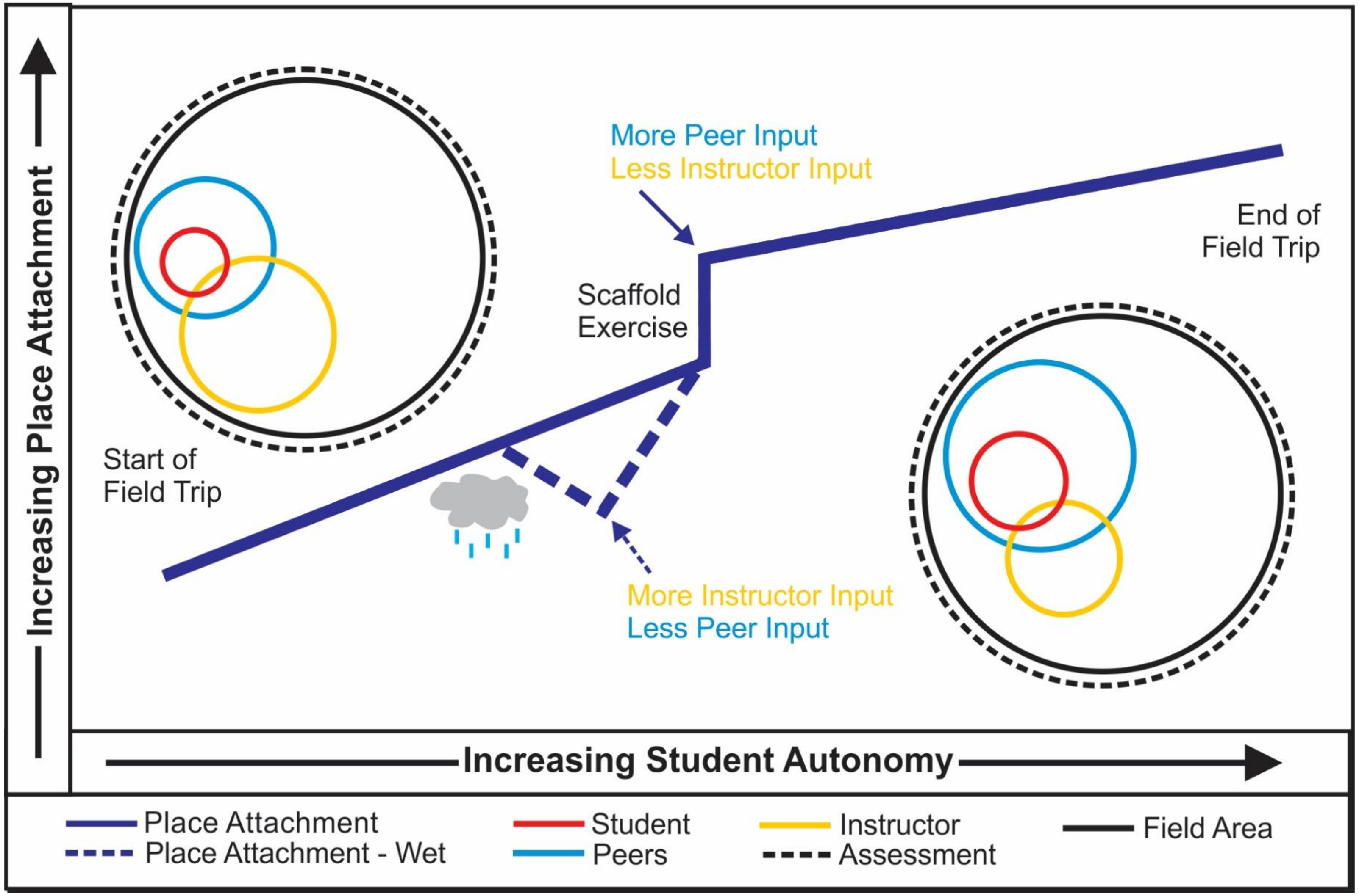

Figure 3.6: Conceptual depiction of the progression between pre- and post-trip place attachment, informed by in-field observations of relative peer and instructor input into teaching and learning conditions. Note that changes in relative input due to instructor adjustments may be in response to completion of an initial assessment (scaffold exercise) or recovery from adverse weather conditions. Conceptual model of situated field trip design from Chapter 2.

PREFACE (CHAPTER 4)

Chapter 4 builds on Chapters 2 and 3 by uncovering connections between sense of place and other aspects of the affective domain (motivation and ecological worldview). It investigates study abroad students from the United States and local New Zealand students on similar, but separate, field trips to the same field area (Figure 4.0). Using work in educational psychology, connections are made between the affective domain and student outcomes, and these are interpreted to make recommendations to improve student outcomes on the study abroad field module. Recommendations for the local field trip were outside the scope of this chapter, but are referred to in Chapter 5 (Implications and Conclusions).

Findings suggest that the study abroad students would benefit from a more applied, environmentally-focused, and/or place-based field curriculum. These lessons have wider ramifications for field-based study abroad programmes worldwide, highlighting the missed opportunities when simply applying curricula and/or hiring instructors from local institutions without being aware of the potential differences between study abroad and local student populations.

Chapter 4 has been submitted to *Frontiers: The Interdisciplinary Journal of Study Abroad.*

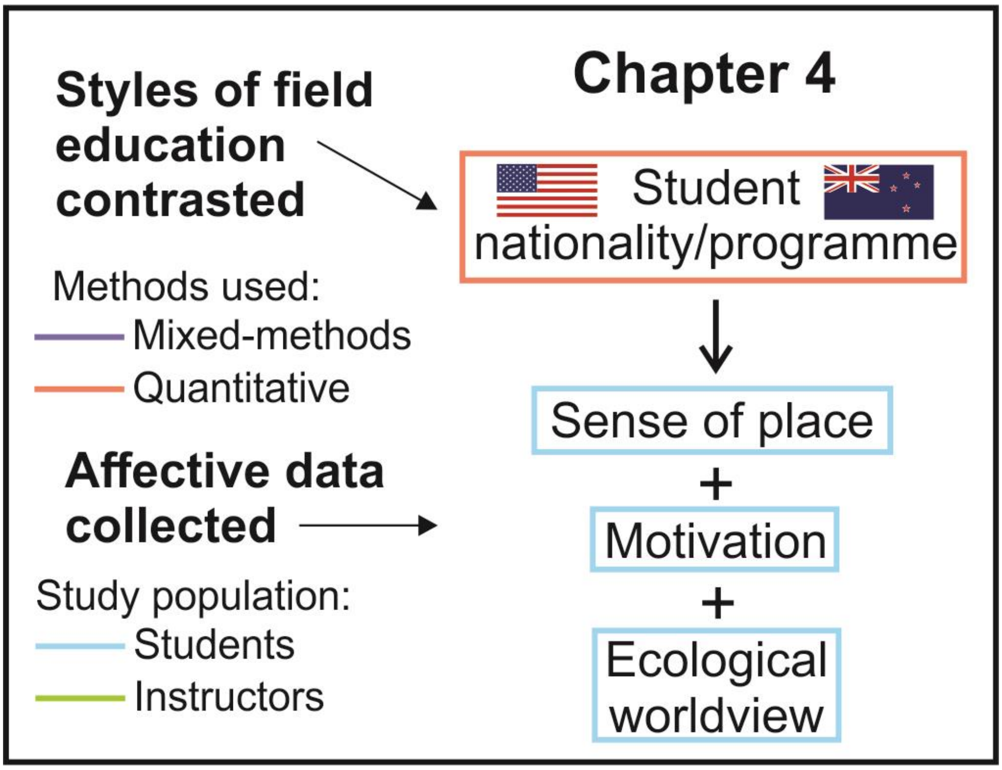

Figure 4.0: Overview of investigation reported on in Chapter 4.

CHAPTER 4: MOTIVATION AND CONNECTION TO EARTH ON GEOLOGY FIELD TRIPS IN NEW ZEALAND: COMPARING AMERICAN STUDY ABROAD STUDENTS WITH LOCAL UNDERGRADUATES

4.1 – Introduction

For many university students, studying abroad is a highlight of their undergraduate experience. The number of students participating in such programs continues to grow, and study abroad has seemingly become part of the higher education "mainstream" (Niser, 2010, p.3). The benefits of study abroad experiences are widespread, spanning personal and professional skills. >90% of students who studied abroad reported increased self-confidence and maturity, greater tolerance for ambiguity, and long-lasting impacts on their worldview (Dwyer and Peters, 2004). Former study abroad students also reported greater interest in academic study and development of skillsets that influenced their future career paths (Dwyer and Peters, 2004). Lastly, students who study abroad develop greater independence, global-mindedness, and intrinsic motivation (Hadis, 2005).

In geoscience, field education has long held a position in the higher education 'mainstream' and its impacts are not unlike those of study abroad programs. Geoscience field education is regarded as beneficial for its development of transferrable skills such as problem solving, synthesis, and teamwork – all relevant for career preparation (e.g., Petcovic et al., 2009; Riggs et al., 2009; Stokes and Boyle, 2009; Whitmeyer and Mogk, 2009, Petcovic et al., 2014). Fieldwork draws students into the geoscience discipline (LaDue and Pacheco, 2013; Petcovic et al., 2014) and helps them develop their geoscientific identities (Petcovic et al., 2014).

The affective domain – broadly defined as emotions, attitudes, and values – is a crucial part of understanding student experiences in the field and why they engage with field learning (e.g., Boyle et al., 2007; Stokes and Boyle, 2009). This research seeks to investigate one broad question:

> *What affective similarities and differences exist between students from the United States studying geology abroad in New Zealand and local students?*

To explain how the affective domain relates to geoscience, van der Hoeven Kraft et al. (2011) developed a model that incorporates unique aspects of the discipline. This model is comprised of three different components: 1) emotion, 2) motivation, and 3) connection to Earth. Two aspects central to the affective domain in geoscience are addressed in this study, and discussed in the following literature review: 1) motivation and 2) connection to Earth. Within the latter, both ecological worldview and sense of place are considered.

4.1.1 – Motivation

Of fundamental concern to student learning is their motivation for doing so (e.g., Bandura, 1977; Dweck, 1986; Deci et al., 1991; Eccles and Wigfield, 2002), guided by a specific orientation (attitudes, goals) of a relative amount (Ryan and Deci, 2000). Self-determination theory addresses motivation by putting the individual and their choices at the core of understanding how these choices translate into actions (Deci and Ryan, 1985). In applying self-determination theory to education, Deci et al. (1991) identified three human needs important for the facilitation of motivation: 1) autonomy, 2) competence, and 3) relatedness. Support of these needs is required for the development of intrinsic motivation, or the desire to engage in a task because it is interesting or challenging (Ryan and Deci, 2000). The counterpart to intrinsic motivation is extrinsic motivation, or the desire to engage in a task because it is perceived to lead to a particular outcome (Ryan and Deci, 2000). Students who are intrinsically motivated have been shown to have greater conceptual understanding than those who are extrinsically motivated (Grolnick and Ryan, 1987). Intrinsically motivated students also tend to hold more engagement and enjoyment in their learning (Benware and Deci, 1984).

In the context of the geoscientific affective domain, van der Hoeven Kraft et al. (2011) highlight interest and self-efficacy, or the belief in the ability to successfully complete a task (Bandura, 1977), as key factors for developing shorter term motivation for learning. They also point out that self-efficacy may be particularly low when students begin a discipline that they have potentially had limited previous exposure to (Hidi and Renninger, 2006), as may be the case with geoscience (e.g., Jolley and Ayala, 2015). LaDue and Pacheco (2013) reviewed studies on interest development in geoscience (Levine et al., 2007; Houlton, 2010; Hoisch and Bowie, 2010). Three central themes emerged from LaDue and Pacheco's (2013) study that were widely consistent with the other studies reviewed: 1) academic experiences (e.g., introductory courses and field trips), 2) connections with people (most commonly instructors and family), and 3) engagement with Earth (e.g., outdoor experiences, travel, and rock/fossil collecting). van der Hoeven Kraft et al. (2011) further suggest that identifying with the content may foster longer term interest in the discipline. Previous work has suggested that the field is a crucial place where students cement their own personal identities as geoscientists (Kastens et al., 2009; Petcovic et al., 2014).

4.1.2 – Connection to Earth

Connections with Earth influence interest in geoscience and continued desire to learn about it (van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013). Here we discuss relationships with the environment/ecology and specific places. Global environmental issues and geopolitics are at the forefront of modern day science and policy. Humans are dependent upon the environment, yet perceive varying degrees of entitlement in resource extraction and management. Geoscience spans fields such as oil and gas, groundwater hydrology, natural hazards, and engineering geology, and students studying geoscience may have variable motivations and interests within the discipline with respect to environmental problems.

Geoscience is increasingly expanding into sub-disciplines that incorporate earth systems science (Church, 1998; Whitmeyer et al., 2009). This disciplinary "paradigm shift" into more systems-oriented earth science (Church, 1998, p. 172) is also reflected in the types of field courses that are offered – research shows that while fieldwork is still widely valued, bedrock mapping is on the decline (Whitmeyer et al., 2009; Petcovic et al., 2014). Fieldwork is instead increasingly interdisciplinary, with added consideration for the interconnected nature of the Earth system (e.g., Trop et al., 2000; Eppes, 2009; Pearce et al., 2010).

Attention to places in which fieldwork is conducted provides a useful way to integrate interactions between people and the landscape. Previous work in human geography and environmental psychology describes the concept of 'sense of place' (e.g., Tuan, 1977; Brandenburg and Carroll, 1995; Willams and Stewart, 1998; Gustafson, 2001; Massey, 2005). Sense of place is formed through experiences, as people sense and perceive spaces and transform them into places through emotion and thought (Tuan, 1977). Two aspects of sense of place are commonly incorporated into management of natural places –

place attachment and place meaning (e.g., Williams and Stewart, 1998; Young, 1999; Williams and Vaske, 2003). Place attachment describes the degree to which a person depends upon and identifies with a place (e.g., Williams and Vaske, 2003; Kyle et al., 2005; Chen et al., 2014). Place meaning describes the attributes which people identify in places (e.g., Young, 1999; Davenport and Anderson, 2005).

van der Hoeven Kraft et al. (2011) highlight place attachment as a potential target to harness student connection to places through geoscience content. Both place attachment and place meaning have been previously investigated in geoscience education (Semken and Butler Freeman, 2008; Chapters 2 and 3 of this thesis). In the field, places are inherently at the center of the educational experience even if only implicitly. Geoscience educators have explicitly incorporated place-based curricula that resulted in a variety of positive affective and cognitive student outcomes (e.g., Riggs, 2005; Semken, 2005; Semken and Butler Freeman, 2008; Williams and Semken, 2011; Monet and Greene, 2012). Even when not intentionally place-based, field trips that concentrate on one or a small number of places produce positive shifts in place attachment (Chapters 2 and 3). In addition, place attachment correlates with pro-environmental behaviours (e.g., Vaske and Kobrin, 2001; Halpenny, 2010), as well as to sensitivity to environmental impacts on that place (White et al., 2008).

The previous sections have highlighted how aspects of the affective domain for geoscience (van der Hoeven Kraft et al., 2011) relate to why and how students learn in the field, through their motivation and connection to Earth. The importance of understanding connection to Earth in the context of increasingly interdisciplinary work in geoscience, with the potential for place-based approaches, was also discussed. In the following sections, we investigate some of the affective characteristics of a group of study abroad students visiting New Zealand. We use comparable data from local undergraduates to identify which of these characteristics set the study abroad students apart. We close with recommendations to further enhance the outcomes of study abroad students in the field.

4.2 – Methods

4.2.1 – Research Setting

This study examined two distinct student populations that undertook similar geological field studies at separate times in the same location: Cass (in the Castle Hill Basin), New Zealand (Figure 4.1). The two groups of students were: 1) US undergraduate geology students studying abroad (referred to herein as "study abroad students") and 2) local NZ undergraduate geology students (referred to herein as "local students"). Study abroad students complete the field trip as a single module of a six-week field camp throughout New Zealand, which is followed by a semester studying at the University of Canterbury in Christchurch (Frontiers Abroad, www.frontiersabroad.com). The students apply and are selected for this programme. Field camps are commonly required coursework for undergraduate geoscience students in the United States, but are not offered at all institutions (Whitmeyer et al., 2009). Combined with the fact that travel is a common reason people choose to study geoscience (LaDue and Pacheco, 2013), the programme is an appealing option for students.

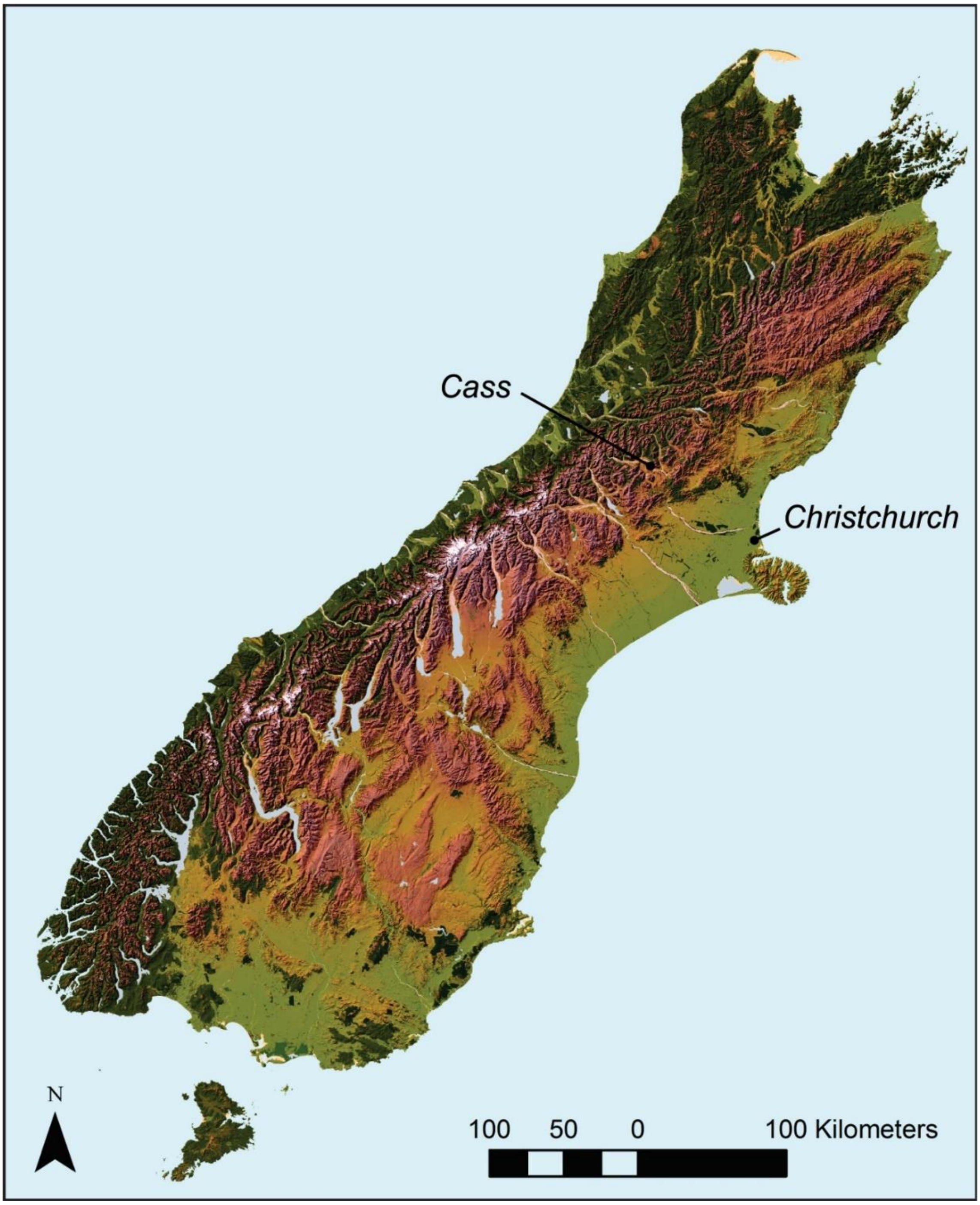

Figure 4.1: Field trip location (South Island, New Zealand).

The local students complete the field trip as a standalone course immediately preceding the beginning of the academic year at the University of Canterbury, Christchurch, approximately one month after the study abroad students complete the equivalent module. The course is not required for completion of an undergraduate degree in geology, but it is required for admission to postgraduate study and is therefore completed by most geology majors. The learning objectives and associated assessments for the two field trips were similar (Table 4.1), with two added short exercises on the trip with the local students.

Table 4.1: Learning objectives.

Study Abroad Field Trip (US Students)		**Local Field Trip (NZ Students)**	
Learning Objectives	**Assessment**	**Learning Objectives**	**Assessment**
Field mapping skills: contacts, structures, geomorphic features	Geologic map	Produce geologic maps of complexly deformed bedrock terranes	Geologic map and stratigraphic log
Interpretation of structural and geomorphic evolution (uplift, deformation and glaciations)	Stratigraphic log	Recognize and measure bedding, cleavage, folds and faults and plot structural measurements on geologic maps	
Prepare geologic cross-sections	Cross-section	Produce geologic cross-sections from bedrock surface exposures	Cross-section
N/A	N/A	Identify and map geomorphic features related to active faulting	Active faulting exercise
N/A	N/A	Identify and map geomorphic features related to glacial processes	Geomorphic map

Most of the students were in their third year of study, though the local students ranged greater in age than the study abroad students (Table 4.2). Both groups had a similar range of ethnicities and number of previous geology field experiences. The gender breakdown was different between the two groups. The study abroad students were 74% female and 26% male, whereas the local students were 19% female and 81% male.

Table 4.2: Demographics of student participants.

Characteristic	Variable	Study Abroad Students (n=23)	%	Local Students (n=31)	%
Gender	Female	17	74	6	19
	Male	6	26	25	81
Age	19	0	0	2	6
	20	16	70	11	35
	21	6	26	8	26
	22	1	4	5	16
	23+	0	0	5	16
Ethnicity	Caucasian/ NZ European/ Pākehā	20	87	28	90
	Māori	0	0	1	3
	Asian	1	4	2	6
	Declined to Answer	2	9	0	0
Major	Geology	13	57	21	68
	Geology & Other Science*	6	26	7	23
	Environmental Geoscience	2	9	0	0
	Geology & Other Non-Science	2	9	3	10
Number of Geology Field Trips Previously Attended	0	1	4	0	0
	1-2	10	43	16	52
	3-4	8	35	9	29
	5+	4	17	6	19
*includes geophysics and geochemistry majors.					

4.2.2 – Survey Instruments and Analysis

Four validated and widely used instruments (the Motivated Strategies for Learning Questionnaire, New Ecological Paradigm Scale, Place Attachment Inventory, and Place Meaning Questionnaire) were used to quantify student motivation and connection to Earth (see Appendix 3.1 for full questionnaire). We elected to only use validated instruments to ensure they measure what is intended, thus reducing uncertainty in interpretation of responses. Furthermore, the selected validated instruments provide points of comparison with other previous studies (e.g., Semken and Butler Freeman, 2008; Shephard et al., 2009). Demographic information, including gender, age, major, and previous field experience was also collected (Table 4.2).

Questionnaires were administered prior to the commencement of field trip activities and were introduced by the lead author. The lead author accompanied the field trips as a researcher and not a tutor, and therefore had no influence over the students' performance in the course. Excerpts from student interviews have been incorporated to help contextualise the quantitative results where appropriate, by providing perspectives behind the data. These excerpts are examples only and qualitative interview analysis was not a part of this study (see Appendix 3.3 for interview protocol).

4.2.2.1 – Motivation

Student motivation was measured using the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrinch et al., 1991). Only the motivation section (31 items) was used, as the learning strategy section was not relevant to the research question in this study. Statements are answered on a Likert scale ranging from 1 (not at all true of me) to 7 (very true of me) and ask about student perceptions generally, as well as specific to the course. There are six internally consistent scales within the motivation section of the MSLQ, each of which is given an average (out of 7) when scoring. 1) Intrinsic goal orientation: degree to which student is motivated by factors such as interest and challenge. 2) Extrinsic goal orientation: degree to which student is motivated by factors such as rewards, grades, and competition. 3) Task value: student perception of how interesting and useful the course is. 4) Control of learning beliefs: belief that student's efforts will result in a positive outcome. 5) Self-efficacy for learning and performance: expectation that student will do well in the course and can master the content. 6) Test anxiety: student stress and worry regarding the completion of tests/exams (high stakes assessments). Note that extrinsic goal orientation and test anxiety are the only constructs in which a lower score is desirable.

4.2.2.2 – Connection to Earth

There is no validated instrument to measure the connection to Earth component, including how people interact with the geology, in its entirety (van der Hoeven Kraft et al., 2011). Instead, we use three separate validated instruments to address some of the values, attitudes and affinities that are highlighted in this component: 1) the New Ecological Paradigm scale (NEP; Dunlap et al., 2000), 2) the Place Attachment Inventory (PAI; Williams and Vaske, 2003), and 3) the Place Meaning Questionnaire (PMQ, Young, 1999).

The NEP contains 15 items which measure a person's pro-environmental orientation on a 5-point Likert scale ranging from strongly disagree to strongly agree (Dunlap et al., 2000). Dunlap et al. (2000) suggest conducting factor analysis on NEP responses before deciding whether to treat the scale as one or multiple constructs. We conducted principal components analysis with a varimax rotation (using SPSS Statistics 24) and found that all components have loadings greater than or equal to 0.325 on the first factor. Furthermore, eigenvalues of 4.01, 1.96, 1.58, and 1.17 suggest that much of the variance can be explained by one factor. Based on this analysis, it is appropriate to use the NEP as one construct (Dunlap et al., 2000). Responses are averaged to give an NEP score out of a maximum of 5, to provide results comparable with another study done in New Zealand (Shephard et al., 2009).

The PAI contains 12 items which use a 5-point Likert scale ranging from strongly disagree to strongly agree to quantify a person's identity with and dependence upon a specific place (Williams and Vaske, 2003). In this case, the place name "Cass" was used on the questionnaire, as it is the name of the field area and station. The instrument was otherwise left unchanged. Responses are totaled to give a place attachment score out of a maximum of 60.

The PMQ asks respondents to indicate how accurate 30 adjectives are in describing a specific place, ranging on a 5-point Likert scale from poor description to excellent description (Young, 1999). As with the PAI, the place name "Cass" was used. The instrument was otherwise left unchanged.

Responses are totaled to give a place meaning score out of a maximum of 150. Higher scores indicate more accurate (excellent as opposed to poor description) and diverse (more adjectives rated as accurate) descriptors.

4.3 – Results and Discussion

4.3.1 – Motivation

The study abroad students had significantly higher intrinsic goal orientation, lower extrinsic goal orientation, higher task value, and lower test anxiety than the local students (Table 4.3). However, they were similar in their control of learning beliefs and self-efficacy for learning and performance. The study abroad students apply for and are accepted on the field camp, and are committed to a further semester of study abroad upon its completion. Therefore, it is perhaps unsurprising that they were more motivated by challenge and interest and less so on grades and fulfilling course requirements than the local students. Prior work suggests that intrinsically motivated students are more successful personally and academically when studying abroad (Chirkov et al., 2007; Chirkov et al., 2008), and that students self-report higher levels of intrinsic motivation after returning (Hadis, 2005).

Table 4.3: Motivated Strategies for Learning Questionnaire results (each construct out of 7).

	Study Abroad (n=23)	Local (n=31)
Intrinsic Goal Orientation^	6.01 (0.65)	4.90 (0.91)
Extrinsic Goal Orientation^, [1]	3.42 (0.92)	5.35 (1.02)
Task Value^	6.41 (0.60)	5.39 (1.01)
Control of Learning Beliefs	5.39 (0.71)	5.71 (0.81)
Self-Efficacy for Learning and Performance	5.30 (0.83)	4.92 (0.98)
Test Anxiety*, [1]	3.50 (1.57)	4.50 (1.28)

Standard deviation in parentheses.
*p=0.01, ^p<0.0001 (Mann-Whitney Test).
[1]Note: lower score is desirable.

Study abroad students also valued the field trip more than the local students did (Table 4.3). Responses to the open-ended questionnaire question "describe why you enrolled in this particular course and field trip stream" (see Appendix 3.1 for questionnaire) were summarised and counted.

Results from this question further clarify the differences between the study abroad and local students (Figure 4.2). The study abroad students gave largely intrinsic reasons for enrolling, including enjoyment of studying in the field, desire to visit New Zealand, interest in the content, and desire to learn/be challenged. Except for the desire to visit Cass, these intrinsic motivators were less prevalent in the local students. Instead, fulfilment of degree requirements was the most widely cited reason for enrolling, with just under one-fifth of the students reporting that they were randomly assigned to the field trip (two parallel trips with similar learning objectives are run in two different locations).

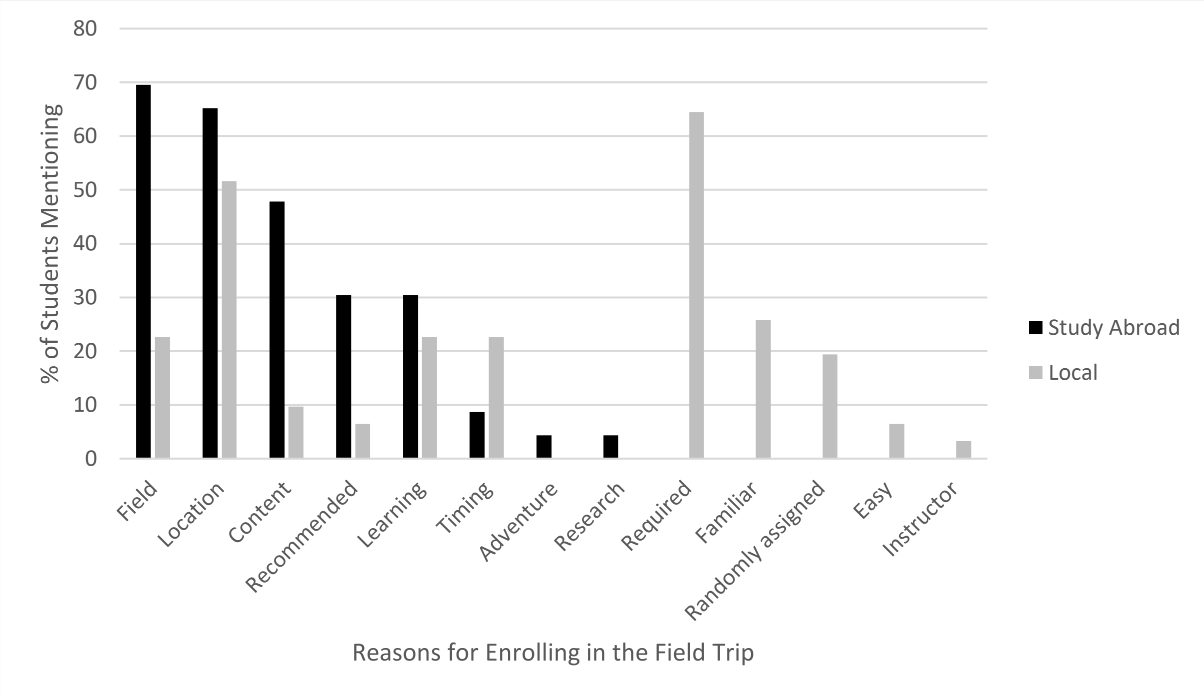

Figure 4.2: Reasons for enrolling in each field trip (Question: “Describe why you enrolled in this particular course and field trip stream”).

Both field trips involved the completion of a suite of assessments, handed in at the end of the field week/module. Students were given feedback while they are in the field, but the assessments comprised the entirety of their grades, and were largely summative in nature (e.g., Knight, 2002; Harlen, 2005; Taras, 2005). Local students’ higher test anxiety (Table 4.3) may in part be attributed to the field trip being a pre-requisite for postgraduate study. In contrast, some of the study abroad students were on a pass/fail system at their home institutions and did not receive grades. This difference in assessment structure may have contributed to the study abroad students’ lower test anxiety (Table 4.3), as they would not have been stressed about what grade they were going to get in the course.

Previous research with the same study abroad program has found the study abroad students report higher levels of confidence in their communication abilities than the local students (Dohaney et al., 2016). Although the students in this study do have significant differences in test anxiety, it is interesting that there were no significant differences between the students in both their control of learning beliefs and self-efficacy for learning and performance (Table 4.3).

4.3.2 – Connection to Earth

4.3.2.1 – Ecological worldview

Study abroad students were on average more pro-environmental than local students, even if not statistically significant ($p=0.13$; Table 4.4). This contrasts with previous work that has found New Zealanders to be more environmentally concerned than Americans on average (Franzen, 2003). Many of the study abroad students also perceived this difference between the two nations, as indicated by this interview excerpt:

> *"Well, I've always been an environmentalist-type person. And like, being in a place that is definitely way greener and more liberal towards like, 'global warming is real, guys!' than you know, the United States. It's nice because people compost, people recycle, people sort all their stuff without even thinking about it. And without bitching about it. Because people in the US bitch about it, like it's some huge, horrible task." – Study Abroad Student 6*

Table 4.4: Connection to Earth results (ecological worldview and sense of place).

	Study Abroad (n=23)	**Local (n=31)[1]**
NEP (/5)*	3.91 (0.51)	3.69 (0.57)
Place Attachment (/60)**	32.39 (6.59)	25.52 (9.20)
Place Meaning (/150)^	104.00 (8.39)	80.61 (18.97)
Standard deviation in parentheses. *p=0.13, **p=0.01, ^p<0.0001 (Mann-Whitney Test). [1]For NEP, n=30 as one student did not answer this section.		

The local students in this study have more pro-environmental attitudes than the average New Zealand undergraduate student (average individual NEP scale scores of 3.69 vs. 2.46; Shephard et al., 2009). These are still not as high as the study abroad students (3.91), though this difference is not statistically significant (p=0.13). Geoscience majors appear to have more pro-environmental views as a whole; however, the liberal arts background of the study abroad students may promote even more pro-environmental views (e.g., Rowe, 2002; Weissman, 2012). Additionally, the two environmental geoscience students in the study abroad group both were more pro-environmental than the average student (4.20 and 4.47 vs. 3.91); however, there are too few of them to confirm whether this is a consistent trend. Regardless of whether or not they major in "environmental geoscience" by label, an individual's relative pro-environmentalism might impact how they see themselves as a geoscientist, or which sub-discipline they wish to pursue. When discussing how they decided to major in geoscience, for example, one student explained:

> *"The human use of the earth [course] was just so awesome. It was 9 AM and everyone else was like juniors and seniors trying to fulfil their science credit…but I was in the front row, the freshman nerd…One day [the instructor] was like, we're gonna spend the next six or seven lectures just on water. And I was like, what the fuck is that? Like what's going on? But then I was like super into it. And I went to office hours to talk to him about it and he told me to take hydrology, which is a 400-level class. And I was a freshman…So it was really scary…But the feeling of really being into it was what totally hooked me." – Study Abroad Student 6*

4.3.2.2 – Sense of place

Even before the field trip had taken place, study abroad students were significantly more attached to the field area and saw significantly more positive and diverse meanings in it than the local students (Table 4.4). Questionnaire responses indicate that only 4% of the study abroad students had ever been to New Zealand before, whereas 29% of the local students had been to the field area previously. At the time of completing the initial questionnaire, study abroad students had been in New Zealand for a total of one week and had only experienced a coastal landscape quite different to the landscape at Cass. The study abroad students' higher intrinsic motivation and task value may explain why they were more readily able to form attachments with and see a variety of meanings in the field area, as interest may develop due to task value and be supported by motivation (Hidi and Renninger, 2006). These students were completely invested in immersing themselves in New Zealand's outdoors to learn about the geology, and the landscape was completely novel to them. When discussing why they decided to come on this study abroad programme, for example, one participant stated:

> *"I mean, the rocks. Also, just adventure. I figured that eventually in being a geologist I'd make it to New Zealand. Just 'cause of the rocks. But I figured that I'd never really have the opportunity to just take off six months and just leave everything and come on an adventure. So, I figured now or never." – Study Abroad Student 5*

In contrast, the local students were only 90 minutes from their university campus and were likely familiar with the type of landscape that the field area was in, even if they had not previously visited the exact place. Those local students that had visited the field area before did have higher average attachment to it than those who had never visited (28.11, n=9 vs. 24.45, n=22), though the difference was not statistically significant (p=0.34, note low n for those that had visited before). An interview with one of these students shows their interest in revisiting and learning more about Cass:

> *"I lived in Christchurch, went to school here. We actually did lots of trips to Castle Hill when I was at school. So, that's why I was real keen to go to Cass. Thought I would do a bit of geology there." – Local Student 3*

This higher attachment is consistent with others that have found differences in attachment after just one visit to a place (Semken et al., 2009; Chapter 2 of this thesis). However, the attachment of local students that had been to the field area before was still not as high as the study abroad students (28.11 vs. 32.39, p=0.30). It appears that novelty and motivation for being on the field trip have a greater influence on attachment than has been recorded with previous visits to a place. This is true even when the students may have discussed differing scientific and outdoor education perspectives during their previous visits, and hence, been previously introduced to a greater range of place meanings. Familiarity alone cannot produce stronger place attachments and meanings than experienced by motivated study abroad students.

4.3.2.3 – Gender differences

One notable difference between the study abroad and local groups is their nearly opposite gender ratios. Statistical analyses indicate that there are significant gender differences in the place attachment ($p=0.01$) and ecological worldview ($p=0.06$) data (MANOVA). Men in this study tend to have stronger place attachment, which is different to what has been previously reported in the literature (for a review see Rollero and De Piccoli, 2010). Previous work has found either no gender differences, or that women have a stronger attachment (Rollero and De Piccoli, 2010). Women in this study tend to be more pro-environmental, consistent with findings in environmental psychology (for a review see Zelezny et al., 2000). No significant differences emerge in the effects of gender and trip together. Although the gender ratio has contributed to some of the trends in our results, we argue that in our case the central unit of analysis is student nationality/programme of study. These demographics are typical for both the study abroad and local groups year to year, and therefore, recommendations are likely to be useful to future years of the programmes.

4.4 – Recommendations

In the following sections, we focus on recommendations for this and other study abroad field trips. Recommendations for the local field trip were outside the scope of this study; however, we expect that many of the broader lessons (e.g., the potential for place-based education and service learning in field education) will also apply to local contexts.

4.4.1 – Specific Recommendations for this Field Trip

Questionnaire results are consistent with literature suggesting that study abroad students are intrinsically motivated and place high value on the learning activities they engage in while overseas (Dwyer and Peters, 2004; Hadis, 2005). Future curricula for this programme should be designed/modified not only to keep students engaged and interested, but also to take advantage of this added potential for learning (Kent et al., 1997). These study abroad students could be assigned more applied content (beyond the geology – see recommendations below), rather than simply transferring over the same curriculum and assessment. However, care must be taken to ensure that these changes do not add too much cognitive load (e.g., Sweller, 1988; Sweller, 1994; Vytal et al., 2012). This is especially important given that the unfamiliar nature of the field environment (and in this case, a new country) also adds stresses on cognitive load (Orion and Hofstein, 1994).

Local field camps often draw upon collective knowledge about the geology of the field area and regional contexts that students obtain from prior coursework completed at their home institution. When instructing modules for study abroad students, acknowledgement needs to be made that these students will not have the same prior contextual knowledge that the local students have built over time. The tendency in this case may be to lean on previously published geological frameworks, which may promote more superficial learning or rote memorisation (e.g., Marton and Säljo, 1984; Trigwell and Prosser, 1991) and less student-centered learning (e.g., O'Neill and McMahon, 2005; Baeten et al., 2010). One solution may be to give students the opportunity to come up with their own descriptions or formal names for the features and stratigraphic units that they map in the area. This process will increase student autonomy and therefore, aid in building connections with the place and its geology (Chapter 2). Using student created descriptions and feature names also reduces the reliance on local geological knowledge, which may be helpful for instructors coming from abroad.

The more pro-environmental worldview of all students in the study (study abroad or local) may reflect the changing nature of the geoscience discipline and increasing focus on climate change and the Earth system (Church, 1998). It is reflective of work indicating that geoscience field education is adapting to be more interdisciplinary and less bedrock mapping-centric (e.g., Whitmeyer et al., 2009; Petcovic et al., 2014). There is added impetus for changes like this in the study abroad group, as they are even more pro-environmental than their local counterparts. Students may be more interested in the environmental aspects of the field landscape, and this could be an added opportunity to incorporate learning about attitudes towards and approaches to environmentalism specific to New Zealand (e.g., Cusick, 2009). For example, the field trip could incorporate discussions of local environmental attitudes (e.g., Shephard et al., 2009), management/conservation (e.g., Valentine et al., 2007), agriculture (e.g., Manderson et al., 2007), or natural hazards (e.g., Orchiston, 2012), or compare these to practices in the United States (e.g., Marshall et al., 2010). These broader contexts may be introduced as students progress through the study abroad module and could even be introduced on a more individual level to those who are more interested in environmental aspects.

Work in environmental psychology suggests that ecological worldviews are likely to influence how students develop a sense of place in the field area (e.g., Gustafson, 2001; van der Hoeven Kraft et al., 2011). It appears that for these study abroad students, the novelty of the field area and New Zealand supports a strong attachment with and positive meanings perceived in it, despite never having visited the field area, let alone the country, before. This novelty may create opportunities for greater interest in and engagement with the field area, which offers rich potential for the application of place-based curricula. Place-based education is structured around field locations and the cultural (human) meanings affixed to them through time. For example, place-based curricula may address local environmental issues (e.g., Gill et al., 2014), or incorporate indigenous knowledge about the field area (e.g., Riggs, 2005; Semken, 2005; Penetito, 2009). On this field trip, future curricula could include the significance of the Castle Hill/Cave Stream limestones for Māori, previous use of the region as a route through to the West Coast in search of pounamu, and rock art/artifact finds (Grey, 2012).

The relevance of place-based education to the geosciences is widely recognised (e.g., Apple et al., 2014a; Apple et al., 2014b, Semken et al., in press). Place-based curricula strengthen place attachment and meaning (Semken and Butler Freeman, 2008) and help to support "reciprocal equity" in places (Ault, Jr., 2008). Gruenewald (2003) put this best when he said, "place-based pedagogies are needed so that the education of citizens might have some direct bearing on the well-being of the social and ecological places people actually inhabit" (p.3). The incorporation of place-based curricula could be extended further to include service learning, directly impacting the local community (e.g., Lewis and Niesenbaum, 2005; O'Steen and Perry, 2012).

4.4.2 – General Recommendations for Study Abroad Field Programmes

The many differences between the study abroad and local students in this study are helpful to consider in implementation of all study abroad curricula. In our experience, it is common for study abroad groups to request curricula and/or hire instructors from local institutions. While local instructors likely offer location-specific knowledge, they may not be familiar with teaching study abroad students or the ways in which they are different from local students. Local instructors might also not know exactly which assessment structure the students' home institutions use (e.g., pass/fail vs letter grades), nor how these structures are implemented in practice. Consequently, expectations may differ between home and local institutions and this may impact student motivation for learning. This is relevant to both curriculum design and intended learning outcomes, as well as how assessments are structured and evaluated. These considerations become increasingly complicated as study abroad programmes accept students from several home institutions. Local instructors then must understand and respond to these differences from multiple perspectives.

The adoption of local curricula may be particularly common in field-based studies, such as geoscience, where groups coming from overseas are unfamiliar with field locations and their geology. However, there is potential to develop field-based curricula to better suit study abroad students and further enhance their learning outcomes. The results of this study highlight the importance of knowing the affective characteristics of the student population, as we have shown with environmental attitudes and sense of place. Addressing these needs through place-based or service learning content will help instructors develop and adapt curricula and assessments to be more relevant to their specific students. We suggest that site-specific geological knowledge, particularly when it relies on prior geological knowledge of the regional context, be at the periphery of these study abroad experiences. Instead, they should focus on transferrable skills and curriculum and assessment design that promotes student-centred learning and exploration of the field area.

4.5 – Conclusions

This study compared the affective experiences of study abroad and local students on two separate, but similar, field trips in New Zealand. Two components were measured using quantitative questionnaires before the field trip: 1) motivation and 2) connection to Earth, the latter of which is specific to the geoscience discipline. Within connection to Earth, ecological worldview, place attachment, and place meaning were investigated. Compared to local students, the study abroad students have on average:

- Higher intrinsic motivation

- Lower extrinsic motivation
- More task value on the field trip
- Lower test anxiety
- More pro-environmental worldviews
- More attachment with the field area
- More positive and diverse impressions of the field area characteristics

These differences suggest that it is not sufficient to apply local curricula to study abroad trips, as is often the case with field-based studies. Nor is it sufficient to bring in local instructors who are unfamiliar with study abroad students. With the above in mind, we make several recommendations to adapt local curricula and inform local instructors in a more effective manner:

- Adjust field area content to a more applied approach beyond geological content
- Incorporate environmental aspects of the landscape, including location-specific approaches
- Develop place-based curricula for study abroad field education, including service-learning

These changes promise to not only result in more motivated and engaged study abroad students, but more environmentally and socially conscious ones too.

CHAPTER 5: IMPLICATIONS AND CONCLUSIONS

Broadly, this thesis aimed to understand some of the experiences of students in the field, particularly surrounding the concept of sense of place, to provide added knowledge and informed recommendations for future field education. Each individual study was conceptualised around comparing sense of place and related aspects of the field experience using field trips with contrasting characteristics. This chapter begins with summaries of the key findings presented within Chapters 2, 3, and 4 (Table 5.1). Next, the findings are extended to broader recommendations for field educational pedagogy. The chapter finishes with a discussion of potential future work to be conducted and final reflections on this thesis.

Table 5.1: Summary of findings in relation to thesis aims and chapter-specific research questions.

Chapter	Thesis Aims	Chapter Research Questions	Key Findings
Chapter 2: Comparison of Roadside and Situated Field Trips	(1) To uncover the nature of the development of sense of place in undergraduate geoscience students in the field (2) To illustrate how the development of sense of place is impacted by differences in field trips or students	(1) How do different types of field trips impact students' place attachment? (2) How does sense of place relate to perceptions of learning on the two differing field modules? (3) Are student perceptions of learning and instructor intentions aligned on the two differing field modules? (a) How does this relate to sense of place?	(1) On average, students significantly increased in their attachment to the situated field area and had no change in their attachment to the roadside field area. (2) The situated field trip utilised more student-centred pedagogy and students became more attached to the field area as they learned more about it. The roadside field trip was less student-centred and did not involve a regional-scale assessment. Students felt spatially disoriented in the field area. (3) Student perceptions were closely aligned with instructor intentions on the situated field trip. This was less true of the roadside field trip. (a) The situated assessment allowed instructors to model landscape appreciation, whereas the discrete roadside assessments did not support student perception of regional geological connections.
Chapter 3: Resilience of Field Trips to Differing Instructors and Weather Conditions	(1) To uncover the nature of the development of sense of place in undergraduate geoscience students in the field (2) To illustrate how the development of sense of place is impacted by differences in field trips or students	How do (1) differing instructors and (2) variable weather conditions impact sense of place and the student field experience?	(1) On average, students on all field trip streams had significant increases in their place attachment. There were no significant differences in attachment between streams, despite variations in instructor pedagogy. Instructors had consistent learning outcomes and valued the field area for its educational opportunities, both of which were clear to students. (2) Inclement weather had no significant impacts on students' sense of place or field experience. The field trip assessment was connected to the landscape and had in-built flexibility for the influence of external factors. Instructors also adjusted student autonomy in response to varied weather conditions.

Chapter 4: Comparison of Study Abroad and Local Students	(2) To illustrate how the development of sense of place is impacted by differences in field trips or students (3) To understand how sense of place relates to motivation and environmental attitudes	What affective similarities and differences exist in (1) motivation and (2) connection to Earth between US study abroad students and local NZ students?	(1) On average, study abroad students were significantly more intrinsically motivated, less extrinsically motivated, placed significantly more task value on the field trip, and had significantly lower test anxiety. Study abroad and local students had no significant differences in their control of learning beliefs and self-efficacy for learning and performance. (2) On average, study abroad students were more pro-environmental (though not statistically significant), and had significantly higher place attachment and place meanings towards the field area.

5.1 – Chapter 2: Comparison of Roadside and Situated Field Trips

Chapter 2 investigated sense of place and its relationship to teaching and learning perceptions on a situated and roadside field trip with the same student population. The findings in this chapter illustrate the importance of pedagogy in developing sense of place, and the potential for place attachment to enhance engagement with the geology. The situated and roadside curricula in this study are typical of many geoscience programmes worldwide, and we therefore assert that the lessons learned are applicable to a variety of contexts.

The students had a significant increase in their attachment to the situated field area, but no significant change in their attachment to the roadside field area. When these findings were incorporated with interview and observational data, five important characteristics of the field experience emerged: 1) the individual student, 2) their peer group, 3) their instructor(s), 4) the landscape (field area), and 5) the field trip assessment (Figure 5.1). These characteristics are important to consider in the design and modification of any field trip curriculum. The relative input (size) and relationship (intersection) of each of these elements will vary depending on the pedagogy of the specific field trip.

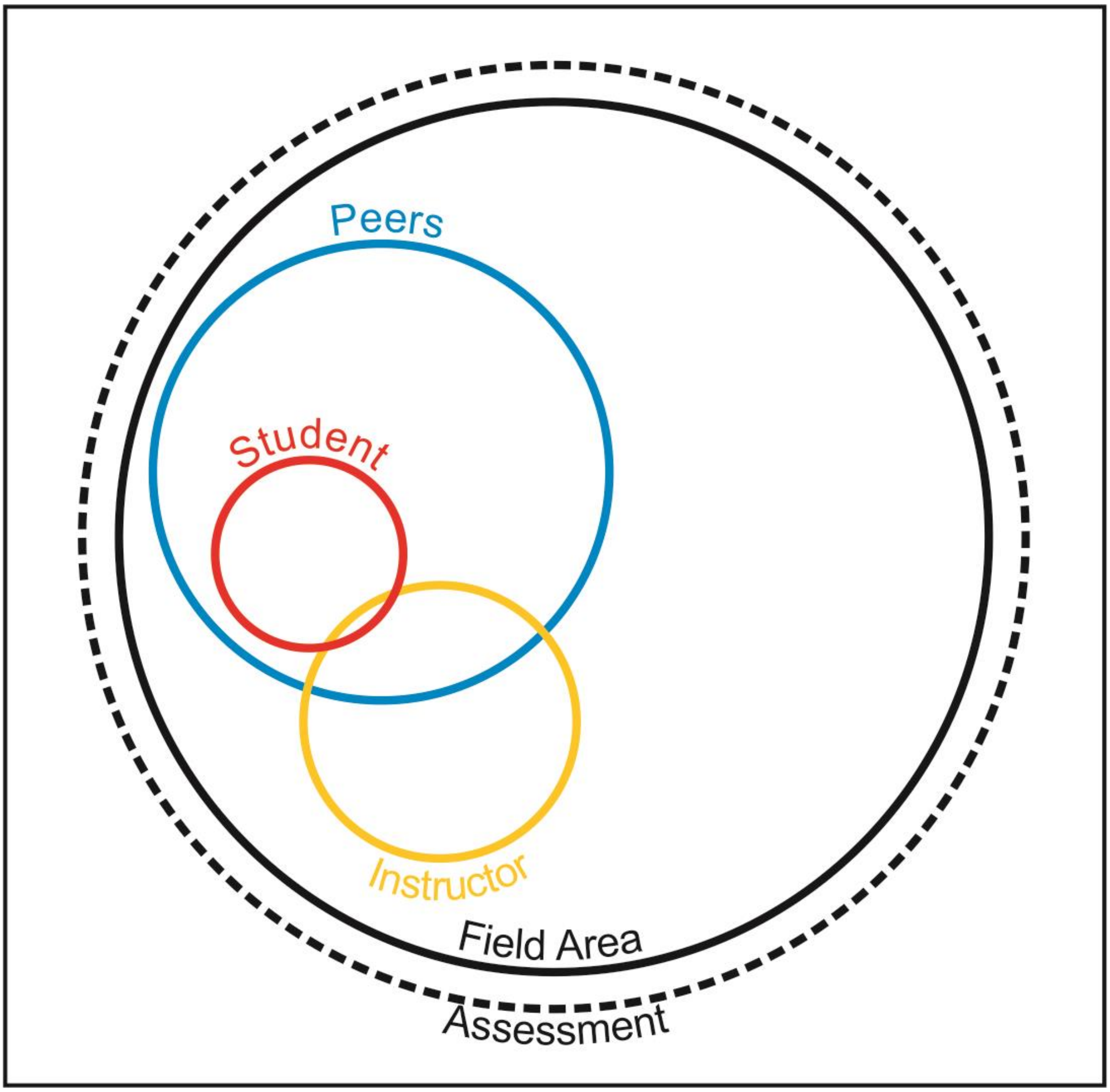

Figure 5.1: Conceptual model of situated field trip design, showing the relative input of an individual student, their peers, and their instructors (Chapter 2). Students operate within their peer groups and all groups are situated within the field area through a field area-wide assessment.

On the situated field trip, the assessment was mapping-based and encompassed the field area, creating an immersive environment where students were largely autonomous. The students' perceived focus on transferrable skills was consistent with instructor intentions. These findings suggest that even when not an explicit objective, situated field trips foster strong attachments with field areas. This place attachment appears to relate to engagement – students describe a greater connection with the landscape through coming to know its geology. Continued implementation of situated field curricula is recommended, but it is important that students continue to have opportunities to be autonomous learners in small group settings.

On the roadside field trip, the assessment was comprised of multiple small exercises related to discrete field sites, with no larger exercise to connect these together regionally. Students were reliant on instructors and much less autonomous than on the situated module. The students' perceived focus on the specifics of the metamorphic core complex was inconsistent with instructor intentions of teaching about the regional geologic history of the field area. We recognise that there are benefits in students observing real world features at a variety of scales – a hallmark of geoscience. However, the roadside field trip in this study was not structured to allow students to discover regional field relationships for themselves. To develop attachments and foster engagement with the geology, we recommend that roadside field trips include a regional assessment where students connect their learning between field sites. This would be further enhanced by incorporating small group autonomy and exploration.

5.2 – Chapter 3: Resilience of Field Trips to Differing Instructors and Weather Conditions

Chapter 3 explored sense of place and its impact on the field experience on multi-stream situated field trips with different instructors and varied weather. The findings in this chapter further reinforce the influence that situated field trips (see Figure 5.1) have on developing sense of place and the importance of student autonomy. Findings also affirm the connections between place attachment and engagement with the geology. Chapter 3 builds on Chapter 2 by identifying specific aspects of situated field trip instruction that help to foster significant increases in student attachment to the field area.

Largely, findings highlighted consistencies in sense of place and the field experience between students on all three of the field trip streams. These findings are encouraging, as they suggest that instructors with distinct pedagogical approaches can be equally beneficial to the sense of place and field experiences of students. Furthermore, dramatic differences in learning conditions caused by the weather, something that we can never control, were responded to successfully by instructors and resulted in comparable experiences on all field trip streams. Instructors had different initial approaches to student autonomy, but all believed in the importance of field education, had similar intended learning objectives, and appreciated the field area for its educational value. The students clearly perceived the learning objectives and appreciated the field area. Flexibility of both the assessment and instructor were crucial to minimising the impact of this on the students.

The conclusions in Chapter 3 (clear learning objectives, appreciation of field area, flexibility of assessment and instruction) are broad and worthy of consideration in any field environment. Therefore, we expect the recommendations to be relevant to a variety of field practitioners, not only when running parallel field trips, but when attempting to maintain consistency of field trips from year to year.

5.3 – Chapter 4: Comparison of Study Abroad and Local Students

Chapter 4 analysed sense of place, motivation, and ecological worldview in US study abroad and local NZ students. The students were on separate week-long field trips with similar curricula in the same field area, approximately a month apart. Chapter 4 builds on Chapters 2 and 3 by uncovering connections between sense of place and other aspects of the affective domain.

Questionnaire results showed that the study abroad students had higher intrinsic motivation and task value, lower extrinsic motivation and test anxiety, were more pro-environmental, and were more attached to and saw more positive and diverse meanings in the field area than local students. These results suggest that the study abroad field module may be enhanced by more applied and environmentally-focused outcomes that can be reached by more intrinsically driven and/or place-based curriculum and assessment. For example, enhancements could be made by incorporating New Zealand or field area specific environmental approaches to geology, including Māori knowledge and concepts such as kaitiakitanga, and could even expand to include service-learning in local communities. Similar changes to curriculum and assessment for the local students may help the students to develop greater intrinsic motivation, more pro-environmental worldviews, and stronger sense of place. Field-based study abroad programmes of all types will benefit from paying closer attention and responding to the differences between their student populations and those of local institutions, for whom the field curricula were often originally designed for.

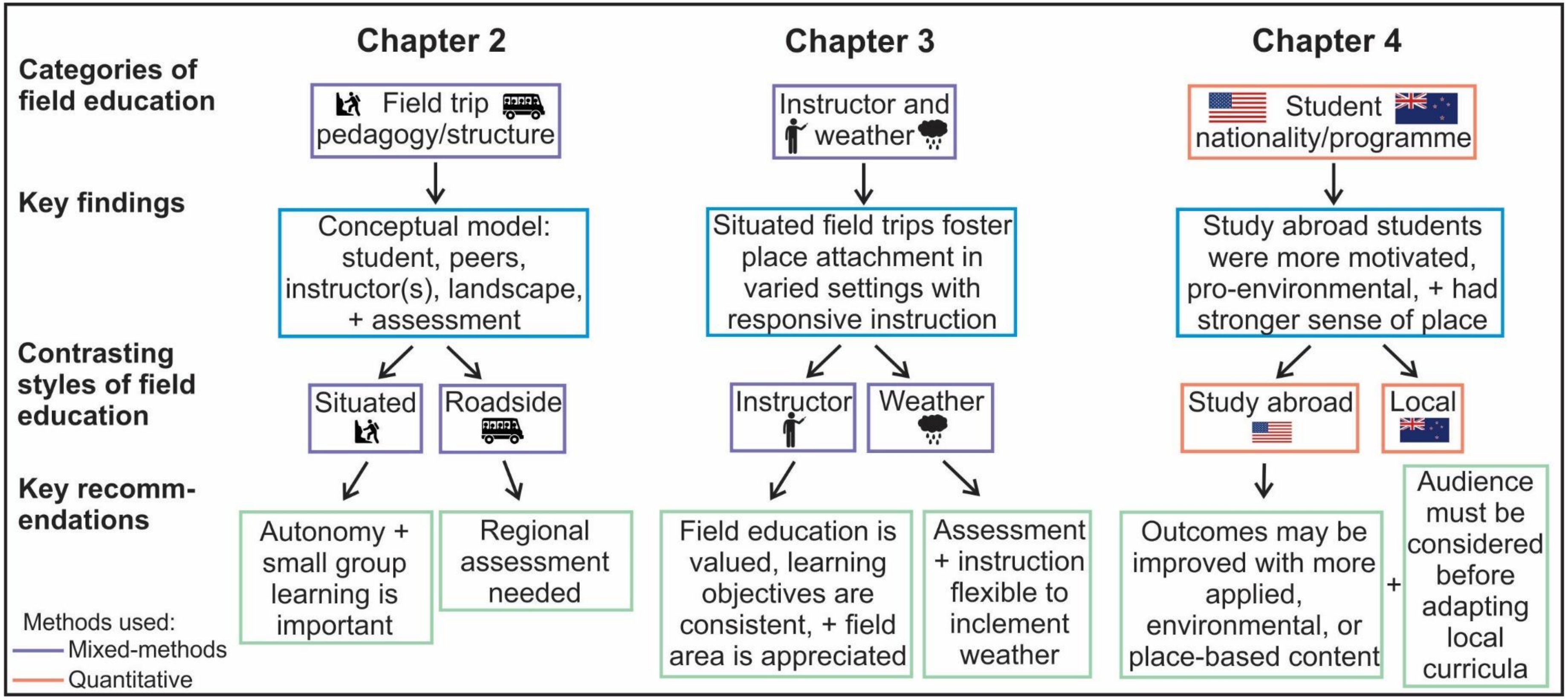

Figure 5.2: Overview of key findings and recommendations presented in each thesis chapter.

5.4 – Contributions and Broad Implications

5.4.1 – Study Context

This thesis responded to recognition of the importance of the affective domain in geoscience by many workers (e.g., McConnell and van der Hoeven Kraft, 2011; van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013). It used the geoscience-specific framework for the affective domain developed by van der Hoeven Kraft et al. (2011) to direct investigations to the key components of motivation and connection to Earth, and was informed by relevant literature from human geography, educational and environmental psychology, and sociology (e.g., Tuan, 1977; Deci et al., 1991; Gustafson, 2001; Deci and Ryan, 2008; Lewicka 2011). van der Hoeven Kraft et al. (2011) identified validated instruments for the measurements of the motivation and connection to Earth components or portions thereof (e.g., Pintrich et al., 1991; Young, 1999; Dunlap et al., 2000; Willams and Vaske, 2003). A selection of these instruments were used in Chapters 2, 3, and 4.

Previously identified gaps in the literature on qualitative studies about the nature of field learning (Riggs et al., 2009) and the construction of student realities in the field (Feig, 2010) provided further impetus for conducting a study of this nature. Based on their study of critical experiences for field geologists, LaDue and Pacheco (2013) suggested that connection to Earth plays a "key role in the development of field geologists" (p. 435). Following leading work in qualitative study of geoscience field education (Feig, 2010; Feig, 2011), a phenomenographic approach to semi-structured interviews and in-field observations was used in Chapters 2 and 3.

5.4.2 – Contributions to Understanding the Benefits, Challenges, and Styles of Field Education

The findings in Chapters 2, 3, and 4 support broad notions of the importance of field learning in geoscience training (e.g., Gold et al., 1991; Fuller et al., 2006; Kastens et al., 2009; Petcovic et al., 2014). They elucidate specific benefits of field education on students' connection to Earth (through sense of place), that are typically grouped under broader headings of 'affective impacts' or 'engagement and interest' (e.g., Boyle et al., 2007; Stokes and Boyle, 2009; Petcovic et al., 2014). Findings in this thesis begin to illustrate the nature of the role that connection to Earth plays in the development of field geologists (LaDue and Pacheco, 2013), and how this varies with the many styles of field pedagogy utilised (Lonergan and Andresen, 1988; Gold et al., 1991). In these respects, this study is novel. Sense of place and its relationship to student field experiences (Figure 5.1) has not previously been characterised for geoscience majors in field settings that were not explicitly place-based, nor has it been contrasted between differing styles of field pedagogy.

The implementation of field pedagogies often varies by instructor (e.g., Dohaney et al., 2015) or is impacted by environmental factors outside of our control (e.g., Fuller et al., 2003; Scott et al., 2006). Factors affecting health and safety, such as weather, illness, and injury, are commonly seen as significant logistical challenges in the continued implementation of field education (e.g., Gold et al., 1991; Manning et al., 1998). Chapter 3 investigated the impact of instructors and weather on student connection to Earth. It is the first work to specifically consider the impact of differences in weather conditions, and provide concrete evidence that comparable student outcomes may be achieved regardless of weather. Chapter 3 illustrated the importance of flexible instruction in responding to inclement weather in ways that maintain safety and student learning outcomes, by adjusting levels of student autonomy relative to instructors, peers, assessment, and the field area (this may be visualised by adjusting circle sizes and interactions, for example, in Figure 5.1). These lessons are important not only in delivering effective field pedagogy, but in justifying how we can and do respond to difficult conditions safely, thereby minimising risk to students and liability in the field.

One other challenging aspect of field education is that it is not a ‘one-size-fits-all’ pedagogy (e.g., Nairn, 1996; Maguire, 1998; Nairn, 1999; Hall et al., 2004; Petcovic et al., 2014). Understanding variations at an individual level, particularly in how students experience the field (e.g., Stokes and Boyle, 2009; Hendricks et al., 2017), is a critical step to improving the wider applicability and enjoyment of field education. The more we know about field experiences of individual students, the more accurately we may be able to replicate field education in lab or virtual settings (e.g., Atchison and Feig, 2011). Through its phenomenographic approach, Chapters 2 and 3 acknowledged and uncovered some of the multiple lived realities of the field. Chapter 4 reiterated the importance of understanding and addressing variations in student populations. These findings relating to individual student differences provide knowledge that may guide the development and implementation of curriculum and assessment that was not previously described in the literature. For example, Chapter 4 identified the enhanced environmental attitudes of US students on a study abroad field camp when compared to local NZ students on a similar field trip. Using this knowledge, curriculum and assessment for the study abroad field trip should be refined to be more interdisciplinary and include environmental connections, to enhance sense of place and engagement.

5.4.3 – Contributions to the Development of (Place-Based) Field Education in Geoscience

The findings in this thesis support the importance and relevance of sense of place to geoscience and field education (e.g., Williams and Semken, 2011; Apple et al., 2014a; Apple et al, 2014b, Semken et al., in press). The places in which we deliver field education are carefully selected to meet logistical and learning objectives (e.g., Lonergan and Andresen, 1988; Gold et al., 1991; Manning et al., 1998). Our findings do not suggest that the ways in which field areas are selected need to change. However, they do suggest that in many cases there may be room for field curricula to adjust to maximise learning potential by incorporating place-based content (Chapters 2 and 4). Place-based education actively incorporates cultural (human) meanings affixed to locations through time (Apple et al., 2014a). As one example, on the roadside field trip where students had no significant change in their attachment to the Westport field sites (Chapter 2), historical changes to coastal settlement and the mining industry could be incorporated in curriculum and assessment. These may help students understand the importance of geology to the place and specifically, how the regional geology influenced landforms, resources, and early settlement (both Māori and Pākehā).

Not only do our findings illustrate that expansions into place-based realms will better serve our students (Chapter 4), but they align with the more interdisciplinary and sustainable approaches to the Earth system that are increasingly important to geoscientists (Church, 1998; Whitmeyer et al., 2009; Petcovic et al., 2014). Although this change is reflected in practitioner attitudes (Petcovic et al., 2014) and select field programmes have become more interdisciplinary (e.g., Eppes, 2009; Pearce et al., 2010), many undergraduate geoscience programme requirements still emphasise the traditional mapping-based field camp (Whitmeyer et al., 2009). Our findings suggest that programme requirements and field curricula need to be less bedrock mapping-centric. For example, curriculum and assessment could highlight interactions between bedrock geology and geomorphology, soil science, vegetation patterns, hydrology, natural hazards, or land-use dynamics. These curriculum and assessment changes need to occur rapidly, to better serve student interest and the changing demands of geoscience industries that have already been documented (Whitmeyer et al., 2009; Petcovic et al., 2014).

Chapters 2, 3, and 4 showed that many instructors and students are appreciative of field landscapes for their educational values, and these landscapes sometimes evoke more personal feelings. Connections to Earth may be addressed more explicitly on these field trips, which are in many ways typical of undergraduate geoscience field trips elsewhere. Our findings further support the suggestions of other workers that there is rich potential for connections with field places to be explicitly developed and leveraged to increase student interest in and engagement with the geology (e.g., van der Hoeven Kraft et al., 2011; Williams and Semken, 2011; Semken et al., in press). Place-based content, particularly with study abroad students with an interest in learning about local contexts (Chapter 4), may be strengthened even further by extending it to explicitly address location-specific geological, environmental, and social challenges (e.g., Tedesco and Salazar, 2006). For example, curriculum and assessment could incorporate applications of bedrock mapping (e.g., resource exploration, hazards assessment, site contamination), present-day land use, or indigenous environmental knowledge, all specific and relevant to the field area studied.

Given the shifting needs of the geoscience discipline, we expect that greater attention to how we interact with the environment and utilise Earth's resources will be beneficial to local and study abroad students. It takes considerable time to find appropriate field areas and build curricula, and therefore, there is sometimes a reluctance to consider changes to them. However, our findings suggest that we could better leverage student connection to Earth in our teaching. Geoscience educators could look within their own field trips and communities for opportunities to build on existing curricula to better serve their students through more explicit incorporation of place.

5.5 – Future Work

This is one of few studies to explore sense of place in geoscience field education and many unanswered questions remain. In this thesis, we provide recommendations at the theoretical level;

however, changes to curriculum and assessment need to be carefully considered before they are made. Student outcomes in response to these changes must also be rigorously evaluated, and in a variety of unique settings. Firstly, we echo calls by Riggs et al. (2009) and Feig (2010) for more qualitative studies of the field educational environment. Secondly, although the piecemeal application of validated instruments was a sufficient measure of connection to Earth, we agree that the geoscience education community would be well-served by the development of a comprehensive instrument (van der Hoeven Kraft et al., 2011). We further suggest that this instrument include explicit measurement of indigenous sense of place, particularly place attachment. Although the Place Attachment Inventory (Williams and Vaske, 2003) inherently includes attachments derived from indigenous knowledge and ancestral locations, the instrument is limited in that it does not differentiate these from other reasons for attachment. We believe it will be useful to differentiate this to better understand our student population and how we can improve design of place-based education.

One might also wonder how time shapes place attachment. For example, does sense of place change after returning from a field trip? Do students become less attached after they return from the field and progress with their studies? Or, do they become more attached when their stress levels decrease and they fixate on the good memories from the field? As they continue to build relationships with their peers throughout their undergraduate degrees, do they become even more attached when they look back on early field trips that shaped these social bonds? How much do peer relationships and social dynamics shape sense of place whilst in the field?

Studies of sense of place would benefit from greater sample sizes to characterise variations at a more detailed demographic level. For example, does previous outdoor experience influence sense of place? Do the gender differences (men having stronger place attachment) reported in Chapter 4 hold in different settings? How does the sense of place of Māori students differ from that of Pākehā students? How strong are the attachments of study abroad students to the field locations they have previously visited in the US? Do NZ geology students visiting other countries experience the same enhanced place attachments at the start of their field trips?

Practicing geoscientists often reflect fondly on their field experiences as students, but we tend to be particularly emphatic about the places in which we conducted independent, longer duration field studies, e.g., postgraduate research. It would be interesting to characterise the sense of place that geoscientists have for these locations.

5.6 – Final Reflections

The complex and rich nature of lived experiences in the field provided a challenging and rewarding research topic. There is still much to be discovered surrounding this topic. While qualitative studies ultimately prove to be more time-consuming and are often less straight-forward to analyse and apply more broadly, they are arguably the best way to truly begin to understand the complexities of individual student experiences in the field. Understanding the variety and complexity in these experiences is crucial to developing more informed and effective field pedagogy, and therefore, improving student outcomes.

The opportunities to better acknowledge and harness sense of place are diverse. They offer meaningful ways to produce graduates who are more environmentally and culturally aware and responsible than past generations, keeping pace with the disciplinary shift of the geosciences into more Earth systems-oriented realms. Not only is this consistent with the progression of the discipline, but it is also consistent with local and global societal issues. Sustainability is imminently important in the challenges we face today, and geoscientists have a real opportunity to make a difference from the ground up.

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CHAPTER 7: APPENDICES

Appendix 1: Publications and Permissions

Appendix 1.1: Co-Authorship Form, Chapter 2

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Co-Authorship Form

This form is to accompany the submission of any thesis that contains research reported in co-authored work that has been published, accepted for publication, or submitted for publication. A copy of this form should be included for each co-authored work that is included in the thesis. Completed forms should be included at the front (after the thesis abstract) of each copy of the thesis submitted for examination and library deposit.

Please indicate the chapter/section/pages of this thesis that are extracted from co-authored work and provide details of the publication or submission from the extract comes:

Chapter 2 – Are we there yet? Sense of place and the student experience on roadside and situated geology field trips. Submitted to "Geosphere".

Co-authors: Dr. Ben M. Kennedy, Dr. Erik Brogt, Dr. Samuel J. Hampton, and Dr. Lyndon Fraser.

Please detail the nature and extent (%) of contribution by the candidate:

Jolley completed the data collection and analysis, and drafted the manuscript (80%).

Dr. Kennedy (6%) helped develop a conceptual model for the manuscript. Dr. Brogt (6%) helped with its structure. Dr. Hampton (4%) helped draft the figures. Dr. Fraser (4%) helped with methods of qualitative analysis. All co-authors assisted in editing the manuscript.

Certification by Co-authors:

If there is more than one co-author then a single co-author can sign on behalf of all

The undersigned certifys that:

- The above statement correctly reflects the nature and extent of the PhD candidate's contribution to this co-authored work
- In cases where the candidate was the lead author of the co-authored work he or she wrote the text

Name: *Ben Kennedy* Signature: Date: *13/07/2017*

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Please indicate the chapter/section/pages of this thesis that are extracted from co-authored work and provide details of the publication or submission from the extract comes:

Chapter 3 – Designing field trips where sense of place and the student experience are resilient to differing instructors and variable weather. Submitted to the "International Journal of Science Education".

Co-authors: Dr. Samuel J. Hampton, Dr. Erik Brogt, Dr. Ben M. Kennedy, Dr. Lyndon Fraser, and Angus Knox.

Please detail the nature and extent (%) of contribution by the candidate:

Jolley completed the data collection and analysis, and drafted the manuscript (75%).

Dr. Hampton (8%) helped maintain connectivity to the teaching and learning environment, and helped refine the figures. Dr. Brogt (5%) helped constrain the qualitative analysis and situate the findings in educational theory. Dr. Kennedy (5%) helped develop a conceptual model and maintained practicality in the recommendations. Dr. Fraser (4%) helped refine the reporting of the research setting. Angus Knox (3%) helped with some of the data collection and contributed to early discussions of observations in the teaching and learning environment. All co-authors assisted in editing the manuscript.

Certification by Co-authors:
If there is more than one co-author then a single co-author can sign on behalf of all
The undersigned certifys that:

- The above statement correctly reflects the nature and extent of the PhD candidate's contribution to this co-authored work
- In cases where the candidate was the lead author of the co-authored work he or she wrote the text

Name: *Ben Kennedy* Signature: Date: *13/07/2017*

Appendix 1.3: Co-Authorship Form, Chapter 4

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This form is to accompany the submission of any thesis that contains research reported in co-authored work that has been published, accepted for publication, or submitted for publication. A copy of this form should be included for each co-authored work that is included in the thesis. Completed forms should be included at the front (after the thesis abstract) of each copy of the thesis submitted for examination and library deposit.

Please indicate the chapter/section/pages of this thesis that are extracted from co-authored work and provide details of the publication or submission from the extract comes:

Chapter 4 – Motivation and connection to Earth on geology field trips in New Zealand: Comparing American study abroad students with local undergraduates. Submitted to "Frontiers: The Interdisciplinary Journal of Study Abroad".

Co-authors: Dr. Erik Brogt, Dr. Ben M. Kennedy, Dr. Samuel J. Hampton, and Dr. Lyndon Fraser.

Please detail the nature and extent (%) of contribution by the candidate:

Jolley completed the data collection and analysis, and drafted the manuscript (80%).

Dr. Brogt (7%) helped refine the recommendations and improve their usefulness to practitioners. Dr. Kennedy (7%) helped with the integration of data sets and recommendations. Dr. Hampton (3%) helped understand the study populations. Dr. Fraser (3%) helped with the integration of qualitative data. All co-authors assisted in editing the manuscript.

Certification by Co-authors:

If there is more than one co-author then a single co-author can sign on behalf of all

The undersigned certifys that:

- The above statement correctly reflects the nature and extent of the PhD candidate's contribution to this co-authored work
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Appendix 1.4: Permission to Reprint the Motivated Strategies for Learning Questionnaire (MSLQ)

http://www.soe.umich.edu/faqs/#36

How to obtain permission to use the Motivated Strategies for Learning Questionnaire (MSLQ)?

The Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia & McKeachie, 1991, exists in the public domain of the internet. All are welcome to use it for valid research purposes, and you are not required to ask permission to use it as long as the instrument is cited appropriately in your writings and publications. Please note the following files are available for download:

- A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ)
- The Making of the Motivated Strategies for Learning Questionnaire
- MSLQ Chapter
- Contact Information

For questions about its specific usage and development please contact some of the people involved in its original development. For those types of inquiries please e-mail: mslq@umich.edu. The MSLQ has been translated into several languages by individual users. For limited information regarding this subject please contact mslq@umich.edu.

Tags: education and psychology

Appendix 1.5: Permission to Reprint the New Ecological Paradigm (NEP) Scale

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Appendix 1.6: Permission to Reprint the Place Attachment Inventory (PAI)

6/30/2017 Gmail - RE: Request to Reprint Survey Originally Published in Forest Science

Gmail **Alison Jolley <alisonjolley@gmail.com>**

RE: Request to Reprint Survey Originally Published in Forest Science

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Jennifer Kuhn <kuhnj@safnet.org> Tue, Jun 27, 2017 at 9:10 AM
To: Alison Jolley <alison.jolley@pg.canterbury.ac.nz>

Dear Allison –

Permission is granted for this requested use. Thank you.

Thanks,

Jennifer

Jennifer Kuhn

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Please see below.

W. Keith Moser

Editor-in-chief Forest Science

---------- Forwarded message ----------
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Date: Jun 21, 2017 8:46 PM
Subject: Request to Reprint Survey Originally Published in Forest Science
To: Warren Moser <moserk@safnet.org>
Cc:

> To: the Editor-in-Chief, Forest Science
>
> I am writing to request permission to reprint a survey originally published in Forest Science in my PhD thesis and associated journal publications. I've used the Place Attachment Inventory to survey undergraduate students on geoscience field trips and would like to include the survey questions as appendices, so as to save the reader tracking down the original citation and avoid any issues they might have with accessing it.
>
> The citation for the original publication is:
>
> Williams, D.R., and Vaske, J.J., 2003, The measurement of place attachment: Validity and generalizability of a psychometric approach: Forest Science, v. 49, p.830-840.
>
> Thank you and do let me know if you require any further information.
>
> Cheers,
>
> -Alison Jolley
>
> --
>
> Alison Jolley, M.Sc.
>
> PhD Candidate, Geoscience Education
>
> Geological Sciences
>
> University of Canterbury
>
> Christchurch, New Zealand
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> Mobile: +64(0)221921660
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Appendix 1.7: Permission to Reprint the Place Meaning Questionnaire (PMQ)

Gmail Alison Jolley <alisonjolley@gmail.com>

RE: Request to Reprint Survey Originally Published in Australian Geographer

D'Mello, Tamara <Tamara.Dmello@tandf.com.au> Fri, Jun 23, 2017 at 12:18 PM
To: Australian Geographer <austgeog@gmail.com>, Alison Jolley <alison.jolley@pg.canterbury.ac.nz>
Cc: Chris Gibson <cgibson@uow.edu.au>

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Tamara

From: Australian Geographer [mailto:austgeog@gmail.com]
Sent: Thursday, 22 June 2017 2:00 PM
To: D'Mello, Tamara <Tamara.Dmello@tandf.com.au>
Cc: Chris Gibson <cgibson@uow.edu.au>
Subject: Fwd: Request to Reprint Survey Originally Published in Australian Geographer

Hi Tamara,

Are you able to assist with this?

Thanks,

Kirstie

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To: "austgeog@gmail.com" <austgeog@gmail.com>

To whom it may concern:

Please see below for a request I sent through to Dr. Gibson, as Editor of Australian Geographer. I've just seen his automatic reply come through so am passing it on to the general inquiries email for Australian Geographer.

Cheers,

-Alison Jolley

--

Alison Jolley, M.Sc.

PhD Candidate, Geoscience Education

Geological Sciences

University of Canterbury

Christchurch, New Zealand

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Executive Counselor - The International Association for Geoscience Diversity

http://www.theiagd.org/

From: Alison Jolley
Sent: Thursday, June 22, 2017 3:50 PM
To: cgibson@uow.edu.au
Subject: Request to Reprint Survey Originally Published in Australian Geographer

Dear Dr. Gibson (Editor-in-Chief, Australian Geographer):

I am writing to request permission to reprint a survey originally published in Australian Geographer in my PhD thesis and associated journal publications. I've used the Place Meaning Survey to survey undergraduate students on geoscience field trips and would like to include the survey questions as appendices, so as to save the reader tracking down the original citation and avoid any issues they might have with accessing it.

The citation for the original publication is:

Young, M., 1999, The social construction of tourist places: Australian Geographer, v. 30, p. 373-389.

Thank you and do let me know if you require any further information.

Cheers,

-Alison Jolley

--

Alison Jolley, M.Sc.

Appendix 1.8: Site Authorisation, Frontiers Abroad

Dr. Darren Gravley
Frontiers Abroad
3 Harbour View Terrace
Lyttelton
Christchurch 8082
New Zealand

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Alison Jolley, M.Sc.
Department of Geological Sciences
University of Canterbury
Private Bag 4800
Christchurch 8140
New Zealand

Re: Site Authorisation

Dear Alison,

I have reviewed your request regarding your proposal entitled, "Connection of geoscience students with field places in New Zealand: implications for informed design of field education". Your request to conduct your research on the Frontiers Abroad field trips located at Kaikoura, Cass, and Westport (GEOL356) is granted. I understand that this research will include field observations (audio-taped), interviews/focus groups (audio-taped) and questionnaires with students, and interviews (audio-taped) with lecturers on these field trips.

This site authorisation covers the period of 6th January, 2015 through 30th September, 2016.

Sincerely,

Darren Gravley

Dr. Darren Gravley
Frontiers Abroad

Appendix 1.9: Site Authorisation, Geological Sciences

Dr. Catherine Reid
Department of Geological Sciences
University of Canterbury
Private Bag 4800
Christchurch 8140
New Zealand

Alison Jolley, M.Sc.
Department of Geological Sciences
University of Canterbury
Private Bag 4800
Christchurch 8140
New Zealand

Re: Site Authorisation

Dear Alison,

I have reviewed your request regarding your proposal entitled, "Connection of geoscience students with field places in New Zealand: implications for informed design of field education". Your request to conduct your research on the field trips located at Cass (GEOL352) and Glens of Tekoa (GEOL240) is granted. I understand that this research will include field observations (audio-taped), interviews/focus groups (audio-taped) and questionnaires with students, and interviews (audio-taped) with lecturers on these field trips.

This site authorisation covers the period of 6th January, 2015 through 30th September, 2016.

Sincerely,

Dr Catherine Reid
Senior Lecturer Palaeontology
Head of Department (Acting)
Department of Geological Sciences
University of Canterbury
Private Bag 4800
Christchurch 8140, New Zealand

Ph intl + 64 3 364 2987 x7764
Fax intl + 64 3 364 2769
catherine.reid@canterbury.ac.nz

Appendix 2: Human Ethics Approvals, Information Sheets, and Consent Forms

Appendix 2.1: Initial Human Ethics Approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2014/137

17 November 2014

Alison Jolley
Department of Geological Sciences
UNIVERSITY OF CANTERBURY

Dear Alison

The Human Ethics Committee advises that your research proposal "The role of place in the field experiences of geology undergraduate students" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 13 November 2014.

Best wishes for your project.

Yours sincerely

Lindsey MacDonald
Chair
University of Canterbury Human Ethics Committee

Appendix 2.2: Amendment 1 Approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2014/137

30 March 2015

Alison Jolley
Department of Geological Sciences
UNIVERSITY OF CANTERBURY

Dear Alison

Thank you for your request for an amendment to your research proposal "The role of place in the field experiences of geology undergraduate students" as outlined in your email dated 23 March 2015.

I am pleased to advise that this request has been considered and approved by the Human Ethics Committee.

Yours sincerely

Lindsey MacDonald
Chair, Human Ethics Committee

Appendix 2.3: Amendment 2 Approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2014/137

22 October 2015

Alison Jolley
Department of Geological Sciences
UNIVERSITY OF CANTERBURY

Dear Alison

Thank you for your request for an amendment to your research proposal "The role of place in the field experiences of geology undergraduate students" as outlined in your email dated 21 October 2015.

I am pleased to advise that this request has been considered and approved by the Human Ethics Committee.

Yours sincerely

Lindsey MacDonald
Chair, Human Ethics Committee

Appendix 2.4: Amendment 3 Approval

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 364 2987, Extn 45588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2014/137 Amendment 3

24 February 2016

Alison Jolley
Department of Geological Sciences
UNIVERSITY OF CANTERBURY

Dear Alison,

Thank you for your request for an amendment to your research proposal "The role of place in the field experiences of geology undergraduate students" as outlined in your email dated 17th February 2016.

I am pleased to advise that this request has been considered and approved by the Human Ethics Committee.

Yours sincerely

Lindsey MacDonald
Chair, Human Ethics Committee

Appendix 2.5: Information Sheet, Lecturer

Alison Jolley, M.Sc. (PhD Candidate)
Department of Geological Sciences
Telephone: +64 3 364 2987 (ext. 7697)
Email: alison.jolley@pg.canterbury.ac.nz
17 November 2014

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

The role of place in the field experiences of geology undergraduate students
Information Sheet for LECTURER participants

As a lecturer taking GEOL240, 352, and/or 356, you are invited to participate in a study addressing the nature of geology field trips as an educational environment, specifically focusing on the places that the trips are held in. Please read the following information, describing the structure of the project and what would be expected of you, should you choose to participate. At any time, you may ask the researcher for clarification.

This project aims to better understand the relationships between second and third year geology undergraduate students and the places in which they learn "in the field". In particular, it asks whether or not students develop a "sense of place" with the physical areas that they study in, and what form this may take. It also asks how the concepts of educational motivation and socio-environmental perceptions impact these perceptions of field places. It is of interest to characterize how the lecturers for these papers perceive socio-environmental issues and specific field places.

If you choose to participate in this study, you will be asked to:

1. Complete **questionnaires** regarding your personal background, socio-environmental perceptions, perceptions of the field trip and field trip location(s) you are taking. *(30 minutes)*
2. Be **observed** by the researcher while you are in the field, who will take notes. These observations will be on and off, as the researcher moves throughout the field. *(duration of the trip)*
3. Complete an **interview** (one-on-one) with the researcher, where you discuss your general field trip experience, perceptions of the field trip location, and perceptions of place-based teaching in more detail. *(1 hour)*

There are no known risks to participating in this study. All questions are optional, and may be refused if you do not wish to answer them. Benefits include: reflecting upon one's own field teaching and facilitation of the learning process, improved understanding of field trip student populations, and the opportunity to voice opinions that will impact future field geology education.

Participation in this study is voluntary and you have the right to withdraw without penalty, prior to publication of results. The results of this study may be published or presented upon to an international audience. In any publication or presentation, complete confidentiality of data will be maintained, by assigning pseudonyms to participants and altering audio files (where necessary). All data will be stored on password protected computers and in locked rooms at the University of Canterbury for 10 years, at which point in time the data will be destroyed.

This PhD project is being carried out under the supervision of Dr. Ben Kennedy (Geological Sciences), Dr. Erik Brogt (Academic Development Group), Dr. Samuel Hampton (Geological Sciences), and Associate Professor Lyndon Fraser (Sociology). Any concerns about your participation in this project may be directed to Dr. Erik Brogt (erik.brogt@canterbury.ac.nz).

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

If you agree to participate in this study, please complete the following consent form and return it to the researcher.

Appendix 2.6: Information Sheet, Student

Alison Jolley, M.Sc. (PhD Candidate)
Department of Geological Sciences
Telephone: +64 3 364 2987 (ext. 7697)
Email: alison.jolley@pg.canterbury.ac.nz
17 November 2014

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

The role of place in the field experiences of geology undergraduate students

Information Sheet for STUDENT participants

As a student in GEOL240, 352, or 356, you are invited to participate in a study addressing the nature of geology field trips as an educational environment, specifically focusing on the places that the trips are held in. Please read the following information, describing the structure of the project and what would be expected of you, should you choose to participate. At any time, you may ask the researcher for clarification.

This project aims to better understand the relationships between second and third year geology undergraduate students and the places in which they learn "in the field". In particular, it asks whether or not students develop a "sense of place" with the physical areas that they study in, and what form this may take. It also asks how the concepts of educational motivation and socio-environmental perceptions impact these perceptions of field places.

If you choose to participate in this study, you will be asked to:

1. Complete **questionnaires** regarding your personal background, educational motivation, socio-environmental perceptions, perceptions of the field trip and field trip location you are currently in. *(45 minutes at the beginning of the trip, 30 minutes at the end of the trip)*
2. Be **observed** by the researcher while you are in the field, who will take notes. These observations will be on and off, as the researcher moves throughout the field. *(duration of the trip)*

Additionally, you may be asked to:

3. Complete an **interview** (one-on-one) or **focus group** with the researcher, where you discuss your general field trip experience and perceptions of the field trip location in more detail. *(1 hour at a convenient time during the trip)*
4. Complete a follow up **interview** (one-on-one) or **focus group** with the researcher, discussing similar topics, approximately 3-4 months after returning from the trip. *(1 hour at a time of your choosing)*

There are no known risks to participating in this study. All questions are optional, and may be refused if you do not wish to answer them. Your involvement in this research will not impact your grades or overall success at the University of Canterbury. Benefits include: reflecting upon one's own field experience and how this facilitates or hinders the learning process, and the opportunity to voice opinions that will impact future field geology education.

Participation in this study is voluntary and you have the right to withdraw without penalty, prior to publication of results. The results of this study may be published or presented upon to an international audience. In any publication or presentation, complete confidentiality of data will be maintained, by assigning pseudonyms to participants and altering audio files (where necessary). All data will be stored on password protected computers and in locked rooms at the University of Canterbury for 10 years, at which point in time the data will be destroyed.

This PhD project is being carried out under the supervision of Dr. Ben Kennedy (Geological Sciences), Dr. Erik Brogt (Academic Development Group), Dr. Samuel Hampton (Geological Sciences), and Associate Professor Lyndon Fraser (Sociology). Any concerns about your participation in this project may be directed to Dr. Erik Brogt (erik.brogt@canterbury.ac.nz).

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

If you agree to participate in this study, please complete the following consent form and return it to the researcher.

Appendix 2.7: Consent Form, Lecturer

Alison Jolley, M.Sc. (PhD Candidate)
Department of Geological Sciences
Telephone: +64 3 364 2987 (ext. 7697)
Email: alison.jolley@pg.canterbury.ac.nz
17 November 2014

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

The role of place in the field experiences of geology undergraduate students
Consent Form for LECTURER participants

I have been given a full explanation of this project and have had the opportunity to ask questions of the researcher.

I understand what is required of me if I agree to take part in the research, and that the results may be published or presented upon to an international audience. I understand that any information or opinions I provide will be kept confidential to the researcher, supervisors, and research assistants and that any published or presented results will not identify participants. I understand that a PhD thesis is a public document and will be available through the UC Library.

I understand that participation is voluntary and I may withdraw all information practically possible to withdraw, prior to publication of results, without penalty.

I understand that all data collected for this study will be stored on password protected computers and in locked rooms and will be destroyed after 10 years.

I understand that I can contact the researcher (Alison Jolley, alison.jolley@pg.canterbury.ac.nz) or supervisor (Dr. Erik Brogt, erik.brogt@canterbury.ac.nz) for further information about the project. If I have any complaints, these should be addressed to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

By signing below, I agree to participate in this research project.

Name (print):

Date:

Signature:

Please include your details below, if you would like to receive a report on the findings of the study at the conclusion of the project.

Email (optional):

Please return this completed consent form to the researcher.

Appendix 2.8: Consent Form, Student

Alison Jolley, M.Sc. (PhD Candidate)
Department of Geological Sciences
Telephone: +64 3 364 2987 (ext. 7697)
Email: alison.jolley@pg.canterbury.ac.nz
17 November 2014

The role of place in the field experiences of geology undergraduate students

Consent Form for STUDENT participants

I have been given a full explanation of this project and have had the opportunity to ask questions of the researcher.

I understand that my participation in this study will not impact my grades in this course or my overall success at the University of Canterbury.

I understand what is required of me if I agree to take part in the research, and that the results may be published or presented upon to an international audience. I understand that any information or opinions I provide will be kept confidential to the researcher, supervisors, and research assistants and that any published or presented results will not identify participants. I understand that a PhD thesis is a public document and will be available through the UC Library.

I understand that participation is voluntary and I may withdraw all information practically possible to withdraw, prior to publication of results, without penalty.

I understand that all data collected for this study will be stored on password protected computers and in locked rooms and will be destroyed after 10 years.

I understand that I can contact the researcher (Alison Jolley, alison.jolley@pg.canterbury.ac.nz) or supervisor (Dr. Erik Brogt, erik.brogt@canterbury.ac.nz) for further information about the project. If I have any complaints, these should be addressed to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

By signing below, I agree to participate in this research project.

Name (print):
Date:
Signature:

Are you willing to participate in interviews or focus groups with the researcher? **Yes / No** **(circle)**

Please include your details below, if you would like to receive a report on the findings of the study at the conclusion of the project.

Email (optional):
Please return this completed consent form to the researcher.

Appendix 3: Instruments and Interview Protocols

Appendix 3.1: Questionnaire

The role of place in the field experiences of geology undergraduate students

Pre-Questionnaire for STUDENT/LECTURER participants

*Note: where applicable, (place name) was replaced with either “Cass”, “the Westport field sites”, or “Glens of Tekoa”. For “the Westport field sites”, the statements were reworded to be grammatically consistent with the plurality of this place name.

Part A (Students)

The following questions ask about your personal background. Please answer as honestly as possible. If you do not wish to answer a question, leave it blank. This is an anonymous survey, but your student number will be used to match pre- and post-trip questionnaires.

1. Gender: ____________________ **2. Age:** ______________________

3. Ethnicity: ____

4. Major(s): ____ **5. Year of Study:** ____________

5a. Previous Post-Secondary Qualification(s): ____________________________________

5b. N/A: ☐

6. Circle any courses from the list below that you have taken at **university level**.

Anthropology	Engineering (any)	History	Physics
Biology	English	Māori and Indigenous Studies	Sociology
Chemistry	Human Geography	Maths	Statistics
Education	Physical Geography	Philosophy	Te Reo Māori

7. List and describe up to 5 **field-based courses** (including short courses and professional development) you have taken in **geology.**

Geology Field Experiences	**Brief description**

8. List and describe up to 5 **outdoors or field-based courses** (including short courses and professional development) you have taken **outside of geology.**

Field Experiences Outside of Geology	**Brief description**

9. List and describe up to 5 **employment positions** you have held in **geology, the outdoors, or a related field**, starting with the most recent.

Job title	Brief description

10. Have you visited (place name) before? **If yes**, please describe when you have visited and what you have done here.

11. Describe why you enrolled in this particular course and field trip stream (where multiple streams were available).

Part A (Lecturers)

The following questions ask about your personal background. Please answer as honestly as possible. If you do not wish to answer a question, leave it blank. This is an anonymous survey.

1. Gender: ______________________ **2.** Ethnicity: _________________________

3. Circle all field trip course(s) led: **GEOL 240** **GEOL 352** **GEOL 356**

4. List and describe all previous university qualifications**.**

Degree title	**Specialisation**	**Location**	**Year Awarded**

5. Other than GEOL240/352/356, list and describe up to 5 **field-based courses** (including short courses and professional development) you have led in **geology.**

Geology Field Experiences	**Brief description**

6. List and describe up to 5 **outdoors or field-based courses** (including short courses and professional development) you have led **outside of geology.**

Field Experiences Outside of Geology	**Brief description**

7. Have you visited (place name) outside of leading this field trip before? **If yes**, please describe when you have visited and what you have done here.

8. Describe your interest in teaching this course and particular field trip stream (where relevant).

Part B (Students)

The following questions ask about your motivation for and attitudes about this class. Remember, there are no right or wrong answers, just answer as honestly as possible. Use the scale below to answer the questions. If you think the statement is very true of you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

	Not at all true of me						Very true of me
1. In a class like this, I prefer course material that really challenges me so I can learn new things.	1	2	3	4	5	6	7
2. If I study in appropriate ways, then I will be able to learn the material in this course.	1	2	3	4	5	6	7
3. When I take a test I think about how poorly I am doing compared with other students.	1	2	3	4	5	6	7
4. I think I will be able to use what I learn in this course in other courses.	1	2	3	4	5	6	7
5. I believe I will receive an excellent grade in this class.	1	2	3	4	5	6	7
6. I'm certain I can understand the most difficult material presented in the readings for this course.	1	2	3	4	5	6	7
7. Getting a good grade in this class is the most satisfying thing for me right now.	1	2	3	4	5	6	7
8. When I take a test I think about items on other parts of the test I can't answer.	1	2	3	4	5	6	7
9. It is my own fault if I don't learn the material in this course.	1	2	3	4	5	6	7
10. It is important for me to learn the course material in this class.	1	2	3	4	5	6	7
11. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	1	2	3	4	5	6	7

12. I'm confident I can learn the basic concepts taught in this course.	1	2	3	4	5	6	7
13. If I can, I want to get better grades in this class than most of the other students.	1	2	3	4	5	6	7
14. When I take tests I think of the consequences of failing.	1	2	3	4	5	6	7
15. I'm confident I can understand the most complex material presented by the instructor in this course.	1	2	3	4	5	6	7
16. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	1	2	3	4	5	6	7
17. I am very interested in the content area of this course.	1	2	3	4	5	6	7
18. If I try hard enough, then I will understand the course material.	1	2	3	4	5	6	7
19. I have an uneasy, upset feeling when I take an exam.	1	2	3	4	5	6	7
20. I'm confident I can do an excellent job on the assignments and tests in this course.	1	2	3	4	5	6	7
21. I expect to do well in this course.	1	2	3	4	5	6	7
22. The most satisfying thing for me in this course is trying to understand the content as much as possible.	1	2	3	4	5	6	7
23. I think the course material in this class is useful for me to learn.	1	2	3	4	5	6	7
24. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	1	2	3	4	5	6	7
25. If I don't understand the course material, it is because I didn't try hard enough.	1	2	3	4	5	6	7

26. I like the subject matter of this course.	1	2	3	4	5	6	7
27. Understanding the subject matter of this course is very important to me.	1	2	3	4	5	6	7
28. I feel my heart beating fast when I take an exam.	1	2	3	4	5	6	7
29. I'm certain I can master the skills being taught in this class.	1	2	3	4	5	6	7
30. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	1	2	3	4	5	6	7
31. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	1	2	3	4	5	6	7

Part C (Students and Lecturers)

Please circle the response below that best describes your agreement with each statement (strongly disagree through strongly agree). Remember, there are no right or wrong answers, just answer as honestly as possible.

1. We are approaching the limit of the people the Earth can support.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
2. Humans have the right to modify the natural environment to suit their needs.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
3. When humans interfere with nature it often produces disastrous consequences.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
4. Human ingenuity will ensure that we do NOT make the Earth unlivable.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
5. Humans are severely abusing the environment.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
6. The Earth has plenty of natural resources if we just learn how to develop them.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
7. Plants and animals have as much right as humans to exist.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
9. Despite our special abilities, humans are still subject to the laws of nature.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
11. The Earth is like a spaceship with very limited room and resources.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
12. Humans were meant to rule over the rest of nature.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
13. The balance of nature is very delicate and easily upset.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree

14. Humans will eventually learn enough about how nature works to be able to control it.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
15. If things continue on their present course, we will soon experience a major ecological catastrophe.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree

Part D (Students and Lecturers)

The following questions ask about your perceptions of the location(s) of this field trip. Please circle the response below that best describes your agreement with each statement (strongly disagree through strongly agree). Remember, there are no right or wrong answers, just answer as honestly as possible.

1. I feel (place name) is a part of me.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
2. (Place name) is the best place for what I like to do.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
3. (Place name) is very special to me.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
4. No other place can compare to (place name).	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
5. I identify strongly with (place name).	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
6. I get more satisfaction out of visiting (place name) than any other.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
7. I am very attached to (place name).	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
8. Doing what I do at (place name) is more important to me than doing it in any other place.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
9. Visiting (place name) says a lot about who I am.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
10. I wouldn't substitute any other area for doing the types of things I do at (place name).	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
11. (Place name) means a lot to me.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
12. The things I do at (place name) I would enjoy doing just as much at a similar site.	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree

Part E (Students and Lecturers)

The following questions ask about the location(s) of this field trip. Please circle the response below that indicates how accurately you think each word describes (place name) (poor description through excellent description). Remember, there are no right or wrong answers, just answer as honestly as possible.

1. Adventurous.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
2. Ancient.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
3. Authentic.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
4. Beautiful.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
5. Comfortable.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
6. Crowded.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
7. Dangerous.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
8. Ecologically important.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
9. Educational.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
10. Exotic.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
11. Fragile	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
12. Fun.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
13. Historical.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description

14. Important for Māori culture.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
15. Important to preserve.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
16. Interesting.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
17. Overdeveloped.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
18. Pristine.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
19. Privilege to visit.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
20. Relaxing.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
21. Remote.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
22. Scenic.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
23. Scientifically important.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
24. Spiritually valuable.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
25. Threatened.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
26. Tranquil.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
27. Tropical.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
28. Unique.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description

29. Unusual.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description
30. Wilderness.	Poor Description	Fair Description	Good Description	Very Good Description	Excellent Description

Appendix 3.2: Observational Approach

The role of place in the field experiences of geology undergraduate students

Observational approach

For the duration of the field trips, the researcher will be present to observe the students and lecturer(s) in the field environment. These observations will be conducted as a non-participant, initiating discussion only for clarification where necessary. The researcher will not be present in a teaching role, minimizing issues with power dynamics. Care will be taken not to observe students who do not consent to the research, which may mean not observing their field partners (even if they have consented to the research). Participants will not be asked to perform any additional tasks beyond what is required of them as part of the field trip curriculum.

The observations serve to broadly and qualitatively contextualize the questionnaires and interviews, by understanding the nature of the field trip on a group level. Observations will be taken by hand, in a field notebook, as the researcher moves throughout the field. In the evenings, time will be spent reflecting upon one's observations by recalling the day's experience. These will in turn serve to create a narrative describing the culture specific to that field trip.

Observations will be loosely guided by the research themes: sense of place, place-based teaching, field pedagogy, socio-environmental perceptions, and educational motivation. However, it is likely that unexpected areas of interest will arise, and therefore, observations will not exclusively focus on these themes.

Appendix 3.3: Interview Protocol, Student

The role of place in the field experiences of geology undergraduate students

Interview topics for STUDENT participants

Using a semi-structured format, students will be asked to discuss various factors relating to their field experience, primarily focusing on their perceptions of the place(s) that the field trip is occurring in. The following topics may be addressed during the interviews, using students' questionnaire responses to generate discussion and tailor individual interview trajectories:

1. The student's personal background
    a. Where are they from?
    b. Where do they consider home?
    c. What are they majoring in (solely geology, or double major)?
    d. Why are they majoring that field?
    e. When did they decide on their major?
    f. Educational motivation or socio-environmental perceptions of interest that arise from the questionnaire.
2. General perceptions of the field trip
    a. What they like/dislike about it.
    b. What do they think the purpose was? What did they learn?
    c. What was most/least useful to learn?
    d. When was it most/least engaging?
3. How the location contributes to or detracts from the field trip
    a. Had they visited this location before? How many times? In what capacity?
    b. What are the most/least beneficial aspects of the location, as an educational environment?
    c. What is their favourite place in the mapped area?
4. Local visitation and education (where "local" is defined specifically for each area)
    a. What activities do they think locals participate in here?
    b. What features of the area do they think locals should learn about?
5. Tourist visitation and education (from further afield than what is defined as local)
    a. What activities do they think tourists participate in here?
    b. What features of the area do they think tourists should learn about? Do they think this should differ from what locals should learn about?
6. Personal interest in the location
    a. Would they return to this field trip location, in their own time?
    b. What types of activities could they see themselves doing?
    c. What are its most interesting/important features?
7. Impact of the field trip on their perceptions of the location
    a. How would they describe their relationship with the location(s)?
    b. Do they remember what their initial impressions were? Has the field trip changed their perceptions of its location(s)?
8. Any additional comments/questions that the interviewee introduces, based on the above series of topics.

Appendix 3.4: Interview Protocol, Lecturer

The role of place in the field experiences of geology undergraduate students

Interview topics for LECTURER participants

Using a semi-structured format, lecturers will be asked to discuss general perceptions of field trips, their own field experiences, place-based teaching, and the specific place(s) in which they lead field trips. The following topics may be addressed during the interviews:

1. The lecturer's personal background
    a. Where are you from originally?
    b. How long have you lived in Christchurch/New Zealand?
    c. How much time do you spend in the outdoors here? What do you do?
    d. How would you describe your research specialty?
    e. How long have you been teaching this field course? What about other courses, at UC or elsewhere? Your uni? How much time spent with FA?
2. Perceptions of field experiences
    a. Do you think field education is valuable for the development of undergraduate geoscientists? Why? Are there any negatives?
    b. Can you think of any of your own examples as a student, demonstrator, or lecturer?
    c. How do you think your students perceive the field experience? Why?
3. General perceptions of the field trip
    a. What is the purpose of this field trip? Why?
    b. How does field teaching differ from in class teaching?
    c. What teaching methods work particularly well in the field? Which don't? Why?
4. How the location contributes to or detracts from the field trip
    a. What are the most important educational features of this field trip location? Why?
    b. How might this place further contribute to field teaching?
    c. What is your ideal field teaching location? Why?
5. Impact of the field trip on their perceptions of the location
    a. Have you visited this location outside of this or other field courses? If so, to do what?
    b. Do you remember the first time you taught a field course in this location?
6. Any additional comments or questions?